

## EVALUATION REPORT ON THE UNIT IPG DE PARIS - INSTITUT DE PHYSIQUE DU GLOBE

### UNDER THE SUPERVISION OF THE FOLLOWING ESTABLISHMENTS AND ORGANISMS:

Institut de Physique du Globe de Paris - IPGP,  
CNRS - Centre national de la recherche  
scientifique,

Université Paris Cité

Université de La Réunion,

IGN - Institut national de l'information  
géographique et forestière,

**EVALUATION CAMPAIGN 2023-2024**  
GROUP D

Rapport publié le 06/09/2024



In the name of the expert committee :

Michel Campillo, Chairman of the committee

For the Hcéres :

Stéphane Le Bouler, acting president

Pursuant to articles R. 114-15 and R. 114-10 of the Research Code, the evaluation reports drawn up by the expert committees are signed by the chairmen of these committees and countersigned by the President of Hcéres.

To make the document easier to read, the names used in this report to designate functions, professions or responsibilities (expert, researcher, teacher-researcher, professor, lecturer, engineer, technician, director, doctoral student, etc.) are used in a generic sense and have a neutral value.

This report is the result of the unit's evaluation by the expert committee, the composition of which is specified below. The appreciations it contains are the expression of the independent and collegial deliberation of this committee. The numbers in this report are the certified exact data extracted from the deposited files by the supervising body on behalf of the unit.

## MEMBERS OF THE EXPERT COMMITTEE

### Chairperson:

Mr Michel Campillo, universit  Grenoble Alpes - UGA  
Mr Christian Sue, universit  de Besan on (UFC) (Vice-Chairman)

### Experts:

Mr Valerio Acocella, Universit  Roma Tre, Italia  
Ms Laurence Audin, IRD - Institut de recherche pour le d veloppement,  
Grenoble  
Mr Vincent Balter, CNRS - Centre national de la recherche scientifique, Lyon  
Mr Olivier Bruguier, CNRS, G osciences Montpellier (representative of  
supporting personnel)  
Ms Agn s Fienga, observatoire de la C te d'Azur - OCA, G oazur, Valbonne  
Mr Albert Galy, universit  de Lorraine, Vand uvre-L s-Nancy (representative  
of CNU)  
Ms Nad ge Hilairet, universit  de Lille, Villeneuve-d'Ascq (representative of  
CoNRS)  
Ms Barbara Schoepp-Cothenet, CNRS, Marseille  
Mr Randell Stephenson, University of Aberdeen, Scotland  
Mr Philippe Vernant, universit  de Montpellier  
Ms Kathryn Whaler, University of Edinburgh, Scotland

## HC RES REPRESENTATIVE

Mr Marc Sosson

## REPRESENTATIVES OF SUPERVISING INSTITUTIONS AND BODIES

Mr Edouard Kaminski, Universit  Paris Cit  Mr  
Marc Chaussidon, IPGP  
Mr St phane Guillot, CNRS Insu  
Mr Nicolas Papparoditis, IGN  
Mr Patrick Mavingui, universit  de la R union

## CHARACTERISATION OF THE UNIT

- Name: Institut de physique du globe de Paris
- Acronym: IPGP
- Label and number: UMR 7154
- Composition of the executive team: Director: Mr. Marc Chaussidon; Administrative manager: Mr. Antoine Charlot; Deputy directors: Mr. Gauthier Hulot, and Mr. Marc Benedetti, Ms. Marianne Greff, Ms. Anne Le Friant, Mr. Arnaud Lemarchand

## SCIENTIFIC PANELS OF THE UNIT

ST Sciences et technologies  
ST3 Sciences de la terre et de l'univers

## THEMES OF THE UNIT

Most of the research activities of the seventeen teams can be described through four themes: Earth and planetary interiors, Natural hazards, Earth system science, Origins.

The first two ones correspond to the "historical" fields of research on which the IPGP was built (first measurement of the magnetic field at Paris in 1882 and first detection of a distant earthquake in 1904) and which are still today at the forefront of the research activities. The Earth is now studied as one of the terrestrial planets of the solar system. These two themes are essential to IPGP because they merge together research, observation and monitoring activities, especially for the four French active volcanoes. The theme "Earth System Science" is rooted in studies of the geochemistry of rivers which developed at the IPGP in 1990 and is key today for IPGP to develop its research in the context of anthropogenic climatic and environmental changes. The theme Origins is also key for the future because it concerns the new frontiers around the origin of life, of the solar system and the Earth, the early Earth, and the emerging new world of exoplanets.

## HISTORIC AND GEOGRAPHICAL LOCATION OF THE UNIT

The research unit was created in 2006 from the merger of seven smaller units into a single one. It groups all the research activities in Earth, environment and planetary sciences hosted by the "Grand Établissement de Recherche et d'Enseignement Supérieur" IPGP, and supported by the five partners (IPGP, UPCité, CNRS, IGN, UR – université de la Réunion). The IPGP itself was created by decree as an Institute in 1921, following activities in meteorology and Earth magnetism which started in 1883 in the St-Maur-des-Fossés campus. IPGP became "Grand établissement" by decree in 1990. UPCité was created (decree of 2019) from the merging of former universities Paris Descartes (Paris 5) and Paris Diderot (Paris 7) and the integration of IPGP as a "Grand établissement".

In the following, IPGP refers to the "Grand établissement", while UMR refers to the UMR 7154 (also named UMR IPGP) and UAR refers to the UAR 3454 (also named UAR IPGP). The IPGP is the only "Grand établissement" existing in France in the field of Earth, environment, and planetary sciences. IPGP has (from the decrees of 1921, 1990 and 2019) three missions: research, observation, and teaching. The UMR groups all the research activities hosted by IPGP, the UAR (co-supervised by IPGP and CNRS) groups all the observation activities hosted by IPGP. IPGP being in charge at UPCité of all teaching activities in the field of Earth, environment, and planetary sciences, through its department DFED (Department of Education and Doctoral Studies, co-supervised by IPGP and UPCité).

The UMR conducts intensive research in all the fields of Earth and environment science (including biology) and planetary sciences, at all scales in time and space. One specific characteristic of most research activities is their very close interaction with all Earth observations (on continents, at sea and from space) of seismic, tectonic, magnetic, and volcanic phenomena, and of the critical zone (see report for the UAR).

The UMR is housed on three campuses. The Cuvier campus (1 rue Jussieu, 75005 Paris) belongs to IPGP and hosts fifteen of the seventeen research groups. The buildings at Cuvier (constructed in 2010 for IPGP) represent 16500 m<sup>2</sup>, 65% of which are being directly used for the research activities. The Paris Rive Gauche (PRG) campus (Lamarck building, 35 rue Hélène Brion, 75013 Paris, 1250 m<sup>2</sup> used) belongs to UPCité and hosts two research groups (Planetary and Space Sciences, Geodesy), the Moufia campus at Saint-Denis belongs to UR and hosts

part of the team Volcanology which is divided between the Cuvier and Moufia campuses. Teaching activities in Paris are split between Lamarck (for undergraduate) and Cuvier (for master).

## RESEARCH ENVIRONMENT OF THE UNIT

As IPGP is supervised by université Paris Cité (UPCité), it participates, alongside the three faculties (Health, Sciences, Humanities and Societies), in the piloting of UPCité and the index UPCité (now called Statex UPCité). The research activities benefit from UPCité Idex funds and those of the foundation UPCité that IPGP co-created with UPCité. IPGP has the responsibility at UPCité of all the teaching in Earth, environmental and planetary sciences in bachelor and master.

The IPGP is part of the Doctoral School 560 Step Up (Sciences de la Terre et de l'Environnement et Physique de l'Univers de Paris).

IPGP is a member of the Labex UnivEarthS (Laboratoire d'Excellence UnivEarthS) with UMR 7164 APC Astroparticle and Cosmology, and UMR 7158 AIM Astrophysics Instrumentation and Modeling and the French aerospace centre ONERA to study the origin and evolution of the processes that have shaped and governed the history and dynamics of the Earth and the Universe.

With the CNRS IPGP participates to national research infrastructure (IR), ForM@Ter in the IR Data Terra (devoted to the extraction, analysis, dissemination and intelligent use of data, indicators and models from national and international observing systems), Ozcar (dedicated to the observation and study of the critical zone), and EPOS (The European Plate Observing System which manages data integration in Earth Sciences).

UMR IPGP is integrated to the Equipex+ (PIA2 and 3) Critex, Marmor (Marine Advanced geophysical Research equipment and Mayotte multidisciplinary Observatory for Research), Gaia Data (to develop and implement an integrated and distributed platform of services/data for accessing FAIR data, products and services for the Earth system biodiversity and the Environment) and Terra Forma (the earth's habitability by developing and testing an in-situ observation platform that relies on smart sensor networks).

The UMR participates to the DIM (Domaine d'intérêt majeur of Île-de-France Region) Origines (2022-2026) and a develop collaboration with other Laboratories (UMR) of the region in astrophysics, planetology, cosmology, and exobiology.

The UMR IPGP benefit of the Programmes et équipements prioritaires de recherche (PEPR) in the 4th Programme d'investissement d'avenir (PIA4) as the PEPR IRIMA (Integrated Risks Management for more resilient societies at the global changes era), PEPR Origins (instrument for the European Giant Telescope (ELT) to characterise exoplanets, new generation of instruments to perform multi-technique and multi-scale analysis, including 3D tomography at the atomic scale of future extraterrestrial samples...) and PEPR Deep Sea (Grands fonds marins)

UMR is recognised as one the "space labs" of Cnes.

## UNIT WORKFORCE: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	38
Maîtres de conférences et assimilés	48
Directeurs de recherche et assimilés	25
Chargés de recherche et assimilés	30
Personnels d'appui à la recherche	115
<b>Sous-total personnels permanents en activité</b>	<b>256</b>
Enseignants-chercheurs et chercheurs non permanents et assimilés	45
Personnels d'appui non permanents	48
Post-doctorants	9
Doctorants	99
<b>Sous-total personnels non permanents en activité</b>	<b>201</b>
<b>Total personnels</b>	<b>457</b>

## DISTRIBUTION OF THE UNIT'S PERMANENTS BY EMPLOYER: in physical persons at 31/12/2022. Non-tutorship employers are grouped under the heading "others".

Nom de l'employeur	EC	C	PAR
IPGP	41	0	57
CNRS	0	40	44
UNIVERSITÉ PARIS-CITÉ	39	0	12
IGN	0	13	1
UNIVERSITÉ DE LA RÉUNION	6	0	1
AUTRES	0	2	0
<b>Total personnels</b>	<b>86</b>	<b>55</b>	<b>115</b>

## GLOBAL ASSESSMENT

UMR IPGP is a research unit of excellence with an indisputable national and international reputation. Its scientific output is outstanding. IPGP's research is supported by state-of-the art analytical platforms, with a vast range of cutting-edge techniques deployed on a largely pooled basis. IPGP has its own extensive computing resources and access to national resources, as well as analog simulations. Research is often highly integrated with observatories, which in turn benefit from the high level of expertise of the whole IPGP staff.

As a member of UPCité, IPGP has access to substantial resources and numerous opportunities for high-level collaboration. CNRS, UPCité, IGN and Université de la Réunion support the Institute's current structure and development projects. Internal organisation is complicated by the large number of teams (17), but the management's strategy, structured around four relevant themes, provides the global vision needed to prepare for changes linked both to advances in the scientific context and to numerous retirements expected in the coming years. Nevertheless, most teams retain their own highly individualised subcultures.

During the visit, the committee noted that all categories of staff are expressing a need for more effective internal communication, and for better listening to their difficulties. This is particularly the case when it comes to the

impact of administrative difficulties on the life of research and the well-being of researchers, and to the management of occupational health and safety problems.

## DETAILED EVALUATION OF THE UNIT

### A - CONSIDERATION OF THE RECOMMENDATIONS IN THE PREVIOUS REPORT

The recommendations of the previous committee were partially followed.

Regarding the recommendation: "The reorganisation of the administrative service must continue with the eventual regrouping of team managers into a single, shared service " significant efforts have been made to improve the organisation of administrative and IT services, and new staff have been recruited.

However, the recommendation on the number of teams has not been followed, but one of the two tiny teams (1 or 2 researchers) has announced its evolution in 2024.

The recommendation concerning the role of themes has been followed.

The quality of information available online continues to vary widely from one team to another.

### B - EVALUATION AREAS

#### EVALUATION AREA 1: PROFILE, RESOURCES AND ORGANISATION OF THE UNIT

##### Assessment on the scientific objectives of the unit

IPGP is developing a long-term scientific strategy based on an in-depth analysis of the evolution of the Earth sciences, their technical resources and their links with the major issues facing our societies. This is particularly evident in the 4 themes that represent the unit's strengths. The fact that strategic discussions and recruitment take these themes into account will help to strengthen the unit's coherent scientific governance.

##### Assessment on the unit's resources

UMR IPGP is France's largest Earth science laboratory, with 145 permanent researchers (C) and teacher researchers (EC), backed up by 115 permanent technical and administrative support staff. The institute hosts around a hundred PhD candidates and as many non-permanent staff. Overall, the age distribution of staff is favourable, but it is worth noting the weakness of certain teams in this respect, as seventeen EC or C will retire within five years. The number of researchers was stable over the evaluation period (30 departures, 32 arrivals).

Institutional financial support is excellent (around 4 M€/year) and stable. Among other things, offering a large number of thesis grants (around 13 new grants per year) besides those funded by research projects. IPGP teams are very successful (around 5 M€/year) in major national programs. The European Union contribution is 3 M€/year.

UMR IPGP has exceptional technical resources at its disposal, with two analytical and computing platforms, rock repositories, the Insu/IPGP ocean-bottom seismometer park, and the IPGP data centre, with support from CNRS, UPCité and the Île-de-France region.

## Assessment on the functioning of the unit

Like the UAR IPGP, the UMR IPGP is part of the larger IPGP establishment. Each of these structures has the same director. The director is assisted by five deputy directors and a general service director. The laboratory is organised around the boards of the "grand établissement" and the RESPEQ (RESPonsable EQUIpe in french) council (equivalent to a management committee extended to team, theme, observatory and platform managers). The committee notes the absence of a laboratory council, usually present in UMR type structures. During the visit, the committee noted that the various categories of staff expressed a need for more effective internal communication, both upwards and downwards, and for better listening and consideration of their difficulties. They expressed a need for prompter action of the management. This is particularly the case when it comes to the impact of administrative difficulties on research life. These communication shortcomings are a critical point for the management of RPS (Psychosocial Risks, Risques psycho-sociaux in french), which is judged to be unsatisfactory by some staff.

### *1/ The unit has set itself relevant scientific objectives.*

#### Strengths and possibilities linked to the context

The organisation of the research strategy is based on an in-depth analysis of the evolution of the Earth sciences and the IPGP's strengths.

The scientific quality of IPGP's staff is outstanding. The unit IPGP is one of the world leaders in Earth sciences, as evidenced by numerous notable achievements: the history of planet formation (transformation of the magma ocean, creation of magnetic fields, evolution of volatile elements and Earth's atmosphere), the deep structure of Mars and its thermal evolution (Insight mission), proof of significant polar wander, and a new explanation for the formation of oceanic lithosphere structure. Major results also include short- and long-term lithospheric deformations, rapid response during the volcanic crisis in Mayotte and the discovery of the largest underwater volcanic eruption, CO<sub>2</sub> fixation by deep microorganisms, critical zone geochemistry, the use of ionospheric science and elastogravity waves to predict seismic hazards, and the evolution of life and early terrestrial environments.

The positive role played by observatories in IPGP's research dynamic is particularly noteworthy in the Natural Hazards theme.

The laboratory's development of priority subjects related to today's societal context offers excellent opportunities, particularly for the Earth System theme.

One announced priority is Space sciences, including planetary seismology, cosmochemistry, remote sensing and geodesy, which represents one of IPGP's great strengths. The emergence of the study of exoplanets, in collaboration with astronomers, is particularly ambitious and timely, and finds a very favourable setting at the IPGP.

#### Weaknesses and risks linked to the context

One risk is that the desire to meet societal interest objectives, as in the Natural Hazards theme, may weaken the energy devoted to fundamental aspects, such as the study of volcanic or seismic processes, for example. The objectives set independently by the seventeen teams are not always fully consistent with the priorities set out in the laboratory's four main structuring themes.

### *2/ The unit has resources adapted to its activity profile and research environment, and makes use of them.*

#### Strengths and possibilities linked to the context

IPGP enjoys strong institutional support. This enables the management to offer recurrent support to researchers via the teams, which nurtures scientific creativity. IPGP researchers have a good capacity to attract funding, and in a rather diverse way from one team to another.

We can expect a positive trend in recruitment over the next few years, with the announced inversion of the GVT (Glissement vieillissement technicité, in french), from 2027 for UPCité.



## Weaknesses and risks linked to the context

One risk for research is the variability in the success of funding calls for projects in terms of recruiting and retaining non-permanent staff, who account for a significant proportion of support. The committee observes a relative weakness in success with ERC calls with respect to the reputation and the expertise of the teams.

*3/ The unit's practices comply with the rules and directives laid down by its supervisory bodies in terms of human resources management, safety, the environment, ethical protocols and the protection of data and scientific heritage.*

## Strengths and possibilities linked to the context

IPGP is a modern, multi-supervised structure, which in principle offers its staff a wide range of opportunities. Central services have been strengthened, opening up opportunities for progress. IPGP started the quantitative evaluation of the impact of its research activity in terms of CO<sub>2</sub> imprint.

IPGP and UPCité are working together on new digital data storage solutions and securing these data. An IR position has been secured to recruit a coordinator for these essential transformations to support the unit's research activities.

## Weaknesses and risks linked to the context

Teams maintain highly individualised subcultures and modes of operation, which are evident at all levels, for all categories of staff.

Discussions with various staff members revealed a clear difference between their perception of the situation and that of the direction, despite the latter's efforts to respond to expectations. An illustration of this is the major difficulties encountered due to financial management problems (unpaid invoices, mission expenses not reimbursed or reimbursed very late and delays in implementing salary raises), which in some cases are a major hindrance to research and damage the IPGP's reputation with suppliers. However, actions have been eventually taken in response to a very difficult and recognised situation. These improvements have not been well communicated to staff, and they seem unaware of how to engage with management to get resolution when issues remain or arise. This question of internal information and the feeling of not being in a structure that is always benevolent in the event of difficulty is amplified in cases of psychological suffering at work.

The regulatory document DUER (Single Occupational Risk Assessment Document or Document unique d'évaluation des risques professionnels in french) does not seem to be available. Safety at work appears as a major problem. The H&S person is only just in post and there is a lot to do, both in terms of fulfilling the regulatory framework but also building trust in processes and procedures and changing uses.

The discussions with staff suggest that parts of the Chambon-la-Forêt campus and the Cuvier campus are not up to the safety standards.

The apparent absence of preparation as of now, for the move of the teams from the Lamark campus to the Cuvier campus, expected in 2026, also raises questions among the staff.

## EVALUATION AREA 2: ATTRACTIVENESS

### Assessment on the attractiveness of the unit

IPGP is an institution of great attractiveness. This is testified, for example, by the very large number (140) of top-quality scientists from foreign institutions (90 countries) who have spent at least one month at IPGP during the period 2017-2022. The UMR IPGP has attracted, and continues to attract (because 58 awards and distinctions over the period 2017-2022, including 1 researcher who received the CNRS silver medal; 4 C/EC as fellows of the American Geophysical Union; and 7 EC elected to the Institut Universitaire de France IUF). The research resources offered over a vast field of study by the platform's set up are unique in France (analysis, simulations, access to instruments and data, etc.).

The IPGP setting offers excellent prospects for young researchers.

- 1/ The unit has an attractive scientific reputation and is part of the European research area.*
- 2/ The unit is attractive because for the quality of its staff support policy.*
- 3/ The unit is attractive through its success in competitive calls for projects.*
- 4/ The unit is attractive for the quality of its major equipment and technical skills.*

Strengths and possibilities linked to the context for the four references above

IPGP is one of the very best European Earth science institutions and has a strong and efficient program for invited scientists.

The recurrent support and the good success in competitive calls allows for attracting numerous PhD students and visiting scientists.

IPGP offers a world-class range of instruments, and facilities (e.g. PARI platform, S-CAPAD platform, OBS park, The Magnetic Measurement Analytical Platform...), in a wide range of activities.

Weaknesses and risks linked to the context for the four references above

One problem of attractiveness is the cost of living in Paris with respect to the salaries. There is also a need to fully solve the problems relative to reimbursements of expenses for the invited scientists.

Several teams have expressed concern about the lack of technical support for their numerical modelling ambitions.

### EVALUATION AREA 3: SCIENTIFIC PRODUCTION

#### Assessment on the scientific production of the unit

Researchers at IPGP have made numerous original contributions in the various domains of research.

The work carried out at IPGP has led to an outstanding number of high-level publications at the highest international standard. The committee notes a good number of early career researchers as lead authors on publications.

- 1/ The scientific production of the unit meets quality criteria.*
- 2/ The unit's scientific production is proportionate to its research potential and properly shared out between its personnel.*
- 3/ The scientific production of the unit complies with the principles of research integrity, ethics and open science. It complies with the directives applicable in this field.*

Strengths and possibilities linked to the context for the three references above

The number of forefront researchers is exceptional at IPGP with overall high publication rate (4.3 pub/year/researcher) for the Institute. All teams have at least a very good productivity if not excellent.

IPGP has a scientific production which complies with the principles of research integrity, ethics, and open science.

We can note the following as a non-exhaustive list of leading edge results: the discovery of seismo-gravity signals after large earthquakes, the multidisciplinary observation of the birth of a submarine volcano offshore Mayotte Island, the discovery of transient gravity signals associated with mass reorganisation at depth, high-resolution optical image correlation for fault and off-fault deformation associated with coseismic and early postseismic signals, discovery of the first detailed internal structure of Mars, from instrument design to data interpretation, the detailed analysis of dust deposition (fluxes and origins) over the Caribbean region, the analysis of the impact of storm-induced precipitation variability on long-term erosion, examination of Critical Zone trajectories during the Holocene period, amino acid production in abiotic terrestrial environments, brought redox constraints favouring mixed reservoirs as the Earth's origin and revealing early oxidation of the Martian crust, a proposition that tidal forces in the proto-moon contributed to its devolatilisation, advances in understanding how the geodynamo operates.

#### Weaknesses and risks linked to the context for the three references above

The age distribution and the strong contribution of some of the oldest researchers could be an issue for some teams, as well as the inflation of the number of subjects.

### EVALUATION AREA 4: CONTRIBUTION OF RESEARCH ACTIVITIES TO SOCIETY

#### Assessment on the inclusion of the unit's research in society

The research carried out at IPGP has many implications for issues of importance to society. In some cases, this is a logical extension of IPGP work, such as volcanology and seismology, and natural hazards in general, which is indeed well considered in the theme Natural Hazard.

This is a long-standing tradition at the institute, rooted in numerous collaborations with institutional players around observatories.

With the current context of environmental change as a result of human activity, fundamental research into our living environment, the critical zone, is becoming a decisive factor for its understanding. This has implications for many areas of science, and is a necessity if we are to respond to the public's questions and concerns, and help build mitigation solutions. IPGP is playing a major part in this through its Earth System theme.

IPGP makes an exemplary contribution to the dissemination of scientific knowledge through a wide range of initiatives aimed at the general public (fundamental geosciences, natural hazards, environmental issues). IPGP researchers play a key role in communication, especially through their numerous appearances in the national media.

IPGP is developing industrial relations based on its expertise in cutting-edge fields, with contracts worth around €400k per year. In particular, it is developing metrology projects with private partners.

- 1/ The unit stands out for the quality and the amount of its interactions with the non-academic world.*
- 2/ The unit develops products for the cultural, economic and social world.*
- 3/ The unit shares its knowledge with the general public and takes part in debates in society.*

#### Strengths and possibilities linked to the context for the three references above

IPGP has a strong network of collaborations outside the academic world for example with CAC 40 companies (as SLB, Lafarge, AXA, EDF, Corning...) to small companies (NanoBactérie, the Scientific and Technical Centre for Building (CSTB)). It has demonstrated its ability to evolve by being heavily involved in the environmental field. In addition to collaborations with industrial partners IPGP members are also involved in training projects in developing countries (testify by the collaboration with IRD and local foreigner institutions).

IPGP has an excellent network of researchers recognised in the public sphere who regularly publish popular works with strong media impact.

Weaknesses and risks linked to the context for the three references above

IPGP should more effectively consider the constantly evolving demands of the general public, students, and various stakeholders regarding the engagement of Earth and environmental sciences within society.

## ANALYSIS OF THE UNIT'S TRAJECTORY

IPGP has an excellent national and international reputation, which has been maintained through the laboratory's evolution and places it in a very favourable position to implement the changes planned in its trajectory.

The most recent topics (such as Earth System) have been well integrated. The IPGP's integration into UP Cité in 2019 offered numerous opportunities for collaboration with research groups of excellence (astrophysics, biology, medicine, political science, etc.) that fit in with its themes.

The trajectory is described in terms of eight challenges, which are relevant but need to be put into better perspective within the structuring framework of the four themes defined for the laboratory.

In terms of human resources, there will be seventeen C/EC retirements, but also four research support staff (PAR : Personnels d'appui à la recherche in French) at crucial positions in the next contract. The laboratory has a range of profiles for future recruitment, in line with its scientific priorities. Bringing several teams together on the Cuvier site will improve scientific synergy and the other aspects of the life of the institute.

## RECOMMENDATIONS TO THE UNIT

### Recommendations regarding the Evaluation Area 1: Profile, Resources and Organisation of the Unit

The scientific reputation and perception of research topics are excellent. Staff are aware of this and find it a source of motivation. Nevertheless, following the Covid crisis, most institutions, including IPGP, have seen their internal social life drastically reduced. IPGP must ensure that its dynamism will not be jeopardised in the midterm by the excessive segmentation of scientific exchanges associated with the large number of teams. This committee reiterates the recommendation of the previous evaluation, encouraging management to prepare a reorganisation to best adapt to the Institute's strategic project.

The detrimental impact the financial situation has had on staff and the reputation of IPGP must be recognised, and the present efforts to get the situation back on track must be sustained and clearly explained to staff. The committee encourages the management to continue its efforts to organise administrative and IT services into poles, in a form that will be discussed with the staff in charge and all stakeholders.

IPGP is not in difficulty in terms of its overall resources, but the committee recommends stepping up efforts on competitive programs such as the ERC, where successes are not always fully commensurate with researchers' potential.

The IPGP's scientific excellence must be complemented by optimum organisation of internal communication, whether in terms of informing everyone about the management's actions and choices of direction, or relaying staff questions and difficulties. Efforts must be stepped up and their impact assessed. A laboratory council would be an internal structure enabling direct contact and discussion between representatives of all groups and management, more easily than in councils including external members.

The committee notes the need for renewed internal reflection on the psychological dimensions of work and associated suffering. Opening up to external services may not be a sufficient solution. The committee recommends setting up an in-house listening unit with appropriately trained personnel that is known to all and that allows for confidential discussions.

This would attest to the IPGP's benevolent consideration for the issue of the quality of life at work. The committee also recommends urgent action on health and safety in the labs. This should include financial support for H&S and that a timetable for addressing deficiencies is drawn up. This timetable should be communicated to stakeholders.

The DUER must be drafted as soon as possible.

The committee supports the announced initiatives to characterise and reduce CO2 impact at laboratory level. It stresses that these initiatives must be led by permanent staff in order to maintain continuity of the action in this field.

### Recommendations Regarding the Evaluation Area 2: Attractiveness

The IPGP's successes, the evolution of its research themes, and the maintenance of its scientific environment (platforms and observatories) contributes to its attractiveness. The committee encourages the laboratory to continue on its ambitious trajectory.

### Recommendations Regarding Evaluation Area 3: Scientific Production

Scientific production is of excellent quality and impressive quantity. The committee encourages IPGP to continue with this level of production.

A discussion about open access journals and alternative ways of publishing (e.g. diamond open access journals) should be instilled at the scale of the institute. As a leading laboratory in Earth Sciences, IPGP could be part of the game-changing initiatives leading to new ways of publishing scientific results.

### Recommendations regarding Evaluation Area 4: Contribution of Research Activities to Society

The committee encourages IPGP in its effective outreach to all audiences. However, it will be necessary to take into account the changing demands of the general public, students and the various stakeholders.

As IPGP is a major institution for fundamental research, it must ensure that the workload of non-academic pursuits, already estimated at 25% of staff time, does not jeopardise the recognition of work on the fundamental processes, the understanding of which at the highest scientific level is key to the Institute's credibility.

## TEAM-BY-TEAM OR THEME ASSESSMENT

**Team 1:** Biogeochemistry at the Anthropocene of Elements and Emerging Contaminant (ACE team)  
 Name of the supervisor: Mr Yann Sivry

### THEMES OF THE TEAM

The team's study focuses on the biogeochemical cycles of metallic elements and emerging contaminants in the critical zone, with particular emphasis on the transport, transfer, and availability of these compounds and how their cycles have changed over the Anthropocene. The team relies on the PARI platform and participates to its development (TOF-ICPMS: Time of Flight Mass Spectrometry) thanks to funds from ANR, CNRS and EU H2020 (ERA.MIN2, Green Deal). The team contributes to research activities to society through the development of the Urban Citizen Observatory of Nanoparticles (NanObs) and collaborations with various industrial partners.

### CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The team is new and is the "allopatric" result of the evolution of the historical BGE team.

### WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	2
Maîtres de conférences et assimilés	2
Directeurs de recherche et assimilés	0
Chargés de recherche et assimilés	0
Personnels d'appui à la recherche	3
<b>Sous-total personnels permanents en activité</b>	<b>7</b>
Enseignants-chercheurs et chercheurs non permanents et assimilés	0
Personnels d'appui non permanents	0
Post-doctorants	0
Doctorants	13
<b>Sous-total personnels non permanents en activité</b>	<b>13</b>
<b>Total personnels</b>	<b>20</b>

### EVALUATION

#### Overall assessment of the team

The ACE team recently derived from the historical BGE and developed innovative research on the cycle of critical metals and emerging contaminants such as nanoparticles. Although ACE is made up of 100% full-time professors and associate professors, with no CNRS researchers, its scientific production is very high. Over the period, the ACE team has authored 133 publications in international, peer-reviewed journals, corresponding to an average of 5.5 publications FTE/year, which is excellent.

However, information regarding the scientific and logistical animation of ACE is vague both in the report and during the visit of the committee.



## Strengths and possibilities linked to the context

A good attractiveness is seen by the increasing number of PhD students, 50% of them being overseas, the recruitment of 1 full professor and 1 associate professor during the period, and also the hosting of visiting scientists.

## Weaknesses and risks linked to the context

The team is 100% full and associate professors and would benefit from the presence of full researcher staff. It is also important to note that, despite sharing common scientific topics and analytical approaches with other IPGP teams, ACE does not collaborate with them (only 7/133 publications). These collaborations could compensate for the involvement of ACE members in teaching.

## Analysis of the team's trajectory

The proposed trajectory, focused on the unique laboratory transversal axis "Earth System" is clearly defined with several axes in the team: physico-chemical characterisation of pollutants, studies on nanoparticles, metals and circular economy (bioleaching and biorefinery). Each of them having their own funding, this strategy is, moreover, secured.

## RECOMMENDATIONS TO THE TEAM

The committee encourages the ACE team to carry on its innovative research on emerging contaminants and toxic metals with broader collaborations with health and social science disciplines, which are well developed at UP Cité. Scientific animation should be strengthened. This is particularly important in a team where full and associated professors are involved in teaching activities. This might be solved by the appointment of a full researcher.

**Team 2:** Cosmochemistry Astrophysics and Experimental Geophysics (CAGE)

Name of the supervisor: Mr Julien Siebert

## THEMES OF THE TEAM

This team addresses questions related to the origin and early evolution of the solar system and terrestrial planets, as well as their structure and composition using an interdisciplinary approach based on forefront analytical, experimental, and numerical methods.

## CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The previous committee already noticed the remarkable quality and quantity of the scientific productions and recommended the CAGE team to continue on this line. During the last contract, the scientific production not only stayed on a high standard but has increased by a factor of 2.5 (from 131 to 318) with almost 15% of these publications in high impact journals.

Other recommendations, such as better integrating PhD students and postdocs in the team life, improving the collaboration with other IPGP teams and welcoming additional researchers have been partly followed. Weekly group seminars and retreats help maintain cohesion of the group. A fruitful partnership was established with at least four other IPGP teams (External Envelope Geochemistry, Geological fluid dynamics, Geomicrobiology and Stable isotope geochemistry). Two members of the team lead the themes "Earth and Planetary Interiors" and "Origin". Lastly, during the last contract the team has been able to attract four new research staff members and one technical staff member, which fully compensated the two departures.

In the publication list, around 40% of the publications are first authored by PhD students or postdocs which highlight the high quality of training and mentorship provided by members of the team. Similarly, the increase in the number of HDRs (+2) represents a positive improvement in the department's supervision capacity, and responds to the recommendation of the previous committee.

## WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	4
Maîtres de conférences et assimilés	1
Directeurs de recherche et assimilés	3
Chargés de recherche et assimilés	1
Personnels d'appui à la recherche	3
<b>Sous-total personnels permanents en activité</b>	<b>12</b>
Enseignants-chercheurs et chercheurs non permanents et assimilés	4
Personnels d'appui non permanents	3
Post-doctorants	5
Doctorants	11
<b>Sous-total personnels non permanents en activité</b>	<b>23</b>
<b>Total personnels</b>	<b>35</b>

## EVALUATION

### Overall assessment of the team

The CAGE team is an extremely dynamic group of interdisciplinary researchers, lecturers, and research support staff. Team members enjoy a very high international profile. CAGE has a very high level of scientific activity, with an excellent scientific output (9.6 publications/FTE/year). Team members are actively involved in high-quality, nationally recognised technical platforms (RÉGEF network), some of which are unique in Europe (Nu Sapphire), and open to outside users. The team is also heavily involved in the training of young researchers (25 PhD students, more than half of them on non-ministerial grants, and 20 postdocs). The team also has an impressive success rate in national (ANR), European (ERC) and international (ESA, NASA) calls, with an overall budget of around €15 million for the period under evaluation.

### Strengths and possibilities linked to the context

A major strength of the team is the multidisciplinary approach it can undertake, and its capacity to collaborate internally. The production of the team is excellent (9.6 publications/year/FTE) with a large number of publications having important breadth/reach, and students and postdocs contribute largely to this success (more than 40% of the publications are first-authored by PhD students and postdocs).

The scientists in the team are internationally recognised in their fields. They received, as well as students, several national and international prizes/distinctions over the period.

The attractiveness of the team is also shown by the numerous visits of confirmed researchers from (prestigious) foreign institutions.

The team has an outstanding ability to succeed in highly competitive European and national calls. The team invests in analytical capacities at the forefront for geochemical analyses.

The team is involved in several ESA, NASA and JAXA space missions.

The team also addresses health-related topics using geochemical methods and is therefore open to societal issues.

### Weaknesses and risks linked to the context

There is a strong gender imbalance for researchers within the group, with only one female researcher.

The team acknowledges the lack of office space for PhD students and postdocs resulting in the spreading of the members and the risk to loosen collaborative connections among team members.

It remained unclear whether there is also space for general team discussions in the team meetings.

A significant proportion of thesis funding came from foreign sources (more than a third) during the evaluation period, which may make the team's activities dependent on certain countries and compromise the PPST (Protection du Potentiel Scientifique et Technique) policy that is tending to become widespread in hard science laboratories, including those involved in fundamental research.

### Analysis of the team's trajectory

The proposed strategy has a large number of axes around the general topic of formation and evolution of the solar system and planets. The topics listed correspond mostly to ongoing European and national projects, which is extremely short-term. What is next is only broadly defined. In the same line, a wealth of profiles for potential hiring are proposed without strong priority.

## RECOMMENDATIONS TO THE TEAM

Over the last contract, the CAGE team has fully confirmed its potential. In terms of activity, scientific output, training, and leadership, the team's track record has been extremely positive, and it is recommended to continue along this path with the same vigour.

An ambitious policy of recruiting new members (researchers and/or technical members) concerns several promising areas of development in fast-growing fields. The team is advised to exert targeted pressure on positions identified as key to its own development, in line with the unit's strategy, as some profiles could benefit other teams. This could also be an opportunity to improve the gender balance of the team.

It is recommended that all students and permanent staff be grouped together on the same level, so as to optimise the training of young researchers, strengthen day-to-day links and intra-team communication.

**Team 3:** Environmental Biogeochemistry (BGE)  
 Name of the supervisor: Mr. Rémi Losno

## THEMES OF THE TEAM

The main research activities of the team are 1) the circulation and biogeochemical role of matter held and transported by the atmosphere, 2) pollution and 3) water systems present on Earth surfaces. The research activities focus on Anthropocene in relation to the recent past Holocene. The team also contributes to the activities of the Observa and OVSG observatories.

The scientific boundaries of BGE with ACE and G2E are difficult to define. The BGE team, though, does not collaborate with either ACE or G2E.

## CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

Previous reports highlighted the absence of a full-time researcher. The arrival of a DR-CNRS is a positive response to this situation. The weakness of the team originating from large involvement in teaching is still perceptible as a non-publishing EC in the team.

A previous report also highlighted the absence of collaborative works with other teams of the IPGP. The present publication list attests 37% of collaborative scientific publications, sign of the integration of the team into the IPGP.

Based on the scientific project and team organisation, the previous report suggested merging with the G2E team. Instead of that, the BGE branched off into two teams: BGE and ACE, with thematic overlap and very limited collaborations with both ACE and G2E teams.

## WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	1
Maîtres de conférences et assimilés	2
Directeurs de recherche et assimilés	1
Chargés de recherche et assimilés	0
Personnels d'appui à la recherche	2
<b>Sous-total personnels permanents en activité</b>	<b>6</b>
Enseignants-chercheurs et chercheurs non permanents et assimilés	1
Personnels d'appui non permanents	1
Post-doctorants	0
Doctorants	4
<b>Sous-total personnels non permanents en activité</b>	<b>6</b>
<b>Total personnels</b>	<b>12</b>

## EVALUATION

### Overall assessment of the team

This team, a continuation of the previous BGE team, benefits from national and international recognition in the field of biogeochemistry and limnology. The scientific production is globally good with 48 publications and a ratio per permanent researcher about 2/researcher/year. But it is worth noting that one lecturer is not publishing.

Success to selective calls and recurrent funding ensure reasonable annual resources for the research activities.

The committee has some concerns about the overlap of the research activities of the team with both the newly created ACE one (pollutants) and the G2E one (critical zone), with very scarce collaborations. Despite the recent arrival of a DR-CNRS, the drop in team size and this thematic overlap raise the weaknesses of the team.

### Strengths and possibilities linked to the context

The research activity of the team is recognised nationally and internationally thanks to an international polar POD project coordination.

### Weaknesses and risks linked to the context

The activity of the team overlaps with two other teams of the IPGP (ACE and G2E) and high involvement in teaching weakens the team.

The organisation of the team is a clear weakness (already mentioned in the previous report), with highly compartmentalised research activity and no perceptible team "life".

### Analysis of the team's trajectory

The proposed trajectory appears not only somehow disperse for a relatively small team with members highly involved in teaching, but also difficult to ascertain:

- focused on the present but in relation to the recent past of the Earth System
- focused on fundamental research but including industrial applications for air and water monitoring
- focused on biogeochemical matter but also pollutants

## RECOMMENDATIONS TO THE TEAM

The committee highly recommends working on strengthening connections with the G2E team, which also studies the fate of non-anthropogenic tracers (contrary to the ACE team, which focuses on pollutants) in the critical zone. Merging both teams should not pose scientific issues.

**Team 4:** External Envelopes Geochemistry (G2E)  
 Name of the supervisor: Mr Julien Bouchez

## THEMES OF THE TEAM

The critical zone's history, present functioning, and future evolution are of special interest to the team G2E, which focuses on the chemical and physical weathering of rocks and subsequent sediment transport in the critical zone. The influence of CO<sub>2</sub> on these processes is particularly evident through the role of plants. To tackle these questions, G2E has a strong background in isotope geochemistry and is committed to the functioning and development of the PARI platform.

The involvement in observatories such as Ozcar is important and acknowledged.

## CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The previous report stated:

*The national and international recognition of works and researchers must allow stronger links with the private sector (Cifre, analytical development with patent...).*

This has been improved by the creation of the spinoff "ExtraLab" which distributes "lab-in-the-field" systems for the high-frequency monitoring of stream chemistry.

*A reflection should be conducted with the possible integration of the biogeochemistry team. The resulting final team would be of a size quite consistent with the structure of the IPGP.*

This recommendation has been partially followed with integration of part of the BGE team.

## WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	2
Maîtres de conférences et assimilés	1
Directeurs de recherche et assimilés	0
Chargés de recherche et assimilés	2
Personnels d'appui à la recherche	3
<b>Sous-total personnels permanents en activité</b>	<b>8</b>
Enseignants-chercheurs et chercheurs non permanents et assimilés	7
Personnels d'appui non permanents	1
Post-doctorants	3
Doctorants	6
<b>Sous-total personnels non permanents en activité</b>	<b>17</b>
<b>Total personnels</b>	<b>25</b>

## EVALUATION

### Overall assessment of the team

This group is at the forefront of the critical zone scientific community's organisation and is a global leader in the study of critical zones evolution with the use of isotopic tracers. Despite a significant staff turnover, the team still has excellent scientific productivity (150 publications in international peer-reviewed journals, corresponding to an average of 4.5 publications FTE/year), supported by a variety of funding sources. The internal scientific and logistical animation of G2E is good.

### Strengths and possibilities linked to the context

The attractiveness has been evident through Mopga (Make Our Planet Great Again), Fulbright and IPGP-UPC fellowships and will certainly be maintained thanks to the resources (Mopga, ITN Marie Curie Initial Training Network programme, ANR, Feder, CNRS Insu and MITI - Mission pour les initiatives transverses et interdisciplinaires in french) and his international network. The implantation in the international Ozcar observatory ensures the team stays at the forefront of the field, while the French TerraForma program and the new European eLTER infrastructure offer new instrumental opportunities.

### Weaknesses and risks linked to the context

The funds obtained by the team are multiple and from diverse origins. The size of the team is however large, and efforts should be done to stimulate applications to selective calls from each of the members. The increase of the size of the team and consequent number of users of the facilities with constant technical staff in charge of these facilities also represents a risk for the access to these facilities.

### Analysis of the team's trajectory

The proposed strategy focuses on Earth System Sciences as a major theme based on straight relations with PARI platform, national Ozcar network and European eLTER network. This axis represents the insured part of the project of the team based on solid and recognised expertise of the team. Besides this major axis, the team aspires to develop links with ecology, that is proposed to be addressed via a new recruitment. This part of the strategy is more questionable.

## RECOMMENDATIONS TO THE TEAM

The committee would suggest to the G2E team to integrate the whole BGE team for obvious scientific reasons and develop trans- and interdisciplinary studies through the Centre des Politiques de la Terre to scale up the geodynamics of critical zones at a decision-making level.

The recognition from which the G2E team benefits should enable them to be more than a partner (as with Edytem Research unit of Université Savoie Mont Blanc and CNRS) but a PI in an ERC project.

**Team 5:** Geodesy  
 Name of the supervisor: Mr Olivier Bock

## THEMES OF THE TEAM

The team research is focused on the definition and construction of terrestrial reference frame using geodetic observations at a large scale, mostly based on space technic. With its fundamental contribution in the construction, update and diffusion of the International Terrestrial Reference Frame (ITRF), the team is a world leader in this domain. They also use geodetic large-scale observations for their interpretation in terms of mass redistribution within the Earth system and the related surface deformations.

## CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

As suggested in the previous report, the team has taken advantage of the fusion with the Lareg team to further strengthen its scientific outputs while maintaining its strengths both in fundamental metrology and broader applications to Earth processes. However, the broader integration of the Lareg staff (of IGN) into IPGP has yet to be performed, but the moving of the team to the Cuvier site in 2025 should help for this integration. i.

## WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	0
Maîtres de conférences et assimilés	0
Directeurs de recherche et assimilés	5
Chargés de recherche et assimilés	8
Personnels d'appui à la recherche	2
<b>Sous-total personnels permanents en activité</b>	<b>15</b>
Enseignants-chercheurs et chercheurs non permanents et assimilés	1
Personnels d'appui non permanents	1
Post-doctorants	0
Doctorants	2
<b>Sous-total personnels non permanents en activité</b>	<b>4</b>
<b>Total personnels</b>	<b>19</b>

## EVALUATION

### Overall assessment of the team

The team is a new team created in 2019 by merging the Lareg team of IGN and the Gravimetry & Space Geodesy from IPGP. The team is a world leader and internationally acknowledged for its major contribution to the ITRF construction, update, and diffusion. Its scientific collaboration with other IPGP teams and observatories should increase when the team will move to the Cuvier site.

In the coming years, this team will suffer from the retirement of some key actors and specific attention should be paid to avoid losing the place of world leader in the domain of ITRF construction.



## Strengths and possibilities linked to the context

The team demonstrates a strong dynamism with significant contributions published. The research of the team is mainly related to large-scale processes (i.e. mass redistribution associated with very large earthquakes, International Terrestrial Reference System). The concepts and tools developed could be beneficial to IPGP teams working on smaller scale deformation processes. The skills and strengths are present at IPGP, they just need to meet to foster further developments. The team has a large visibility at the international level as a major contributor in the construction of the ITRF, acknowledged in 2012 for its role and importance for sustainable development by UN. Each paper associated with a new release of ITRF is highly cited since ITRF is a corner stone of many geodetic studies worldwide. At the national level, the team is also a major actor in the space geodesy community under the supervision of IGN and Cnes.

## Weaknesses and risks linked to the context

The worldwide acceptance for the IPGP team to lead the ITRF development relies a lot on the personality of a researcher close to retirement. The retirement of such key actors will be an issue, especially in the very competitive environment of space geodesy.

## Analysis of the team's trajectory

The team notes 'a strong involvement in the national and international services' but also a difficulty to interact with other researchers due to 'The location in the Lamarck building hampers daily discussions with researchers from almost all other IPGP teams'. This could explain the gap between the Geodesy team and 'field' geodesists/geophysicists either at IPGP in the observatories or in other French laboratories. For example, the team does not seem to be involved in the RENAG SNO where studies and developments are pursued on intracontinental deformation and where discussions could lead to fruitful collaborations, specifically on the noise/signal research topic of the team. At a local scale, it is surprising to see that no mention is made of the GNSS observation of volcanos or subduction induced deformation maintained by the IPGP UAR, a stronger collaboration of the geodesy team in the geodetic observations of the IPGP would benefits to both? The relocation of the team on the Cuvier site is a key aspect of the team trajectory. Hopefully, interactions with other teams such as Geomagnetism, Tectonics and mechanics of the lithosphere or Planetology and Space Sciences and observatories of IPGP will develop in the coming years. Water mass displacements is also clearly an open door for collaboration with other IPGP teams, especially in the context of the Earth system and Natural Hazards themes. IGN PhD grants have been an asset for the team to build on training.

## RECOMMENDATIONS TO THE TEAM

It will be beneficial to have the Geodesy team located in the same building as the other IPGP teams using geodetic techniques for field observations. Discussions will have to be organised, maybe through meetings to further develop the collaborations and most likely lead to very interesting new developments. Very quickly in the next few years the French Space Geodesy community will have to face the retirement of an essential actor in the ITRF construction. This activity is the heart of the Geodesy team with a place of world leader and a specific attention has to be paid in order to maintain the knowhow and international recognition in the team.

**Team 6:** Geological Fluid Dynamics  
 Name of the supervisor: Mr Olivier Devauchelle

## THEMES OF THE TEAM

Geological Fluid Dynamics (GFD) is a legacy component of IPGP aimed at addressing all aspects of 'flow' within and on the Earth via modelling in order to test observational hypotheses. This remains its basic scientific method though with greater and greater emphasis more recently on numerical modelling (in addition to analogue modelling). Such a wide-ranging scientific remit means that GFD carries out research falling into all four of IPGP's integrative themes (Earth and planetary interiors, Earth's magnetic field, Natural hazards, Earth system sciences). GFD has been a driving force and maintains a prominent role in developing and maintaining supercomputing capabilities within IPGP as a whole.

## CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

Previous recommendations were mainly expressed as aspirations for the team to grow levels of production and funding at levels existing at the time. In regard to this, there appears to be little deviation since then, no clear growth trajectory but essentially maintaining both, excluding a Covid-related temporary drop. It was also recommended that the team explicitly evaluate, in terms of a 'cost-benefit' type analysis, whether there remained justification of the existence of the team as a separate entity within IPGP. In this regard, there was no explicit evidence shared that this had been done.

## WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	3
Maîtres de conférences et assimilés	5
Directeurs de recherche et assimilés	2
Chargés de recherche et assimilés	1
Personnels d'appui à la recherche	5
<b>Sous-total personnels permanents en activité</b>	<b>16</b>
Enseignants-chercheurs et chercheurs non permanents et assimilés	3
Personnels d'appui non permanents	0
Post-doctorants	1
Doctorants	5
<b>Sous-total personnels non permanents en activité</b>	<b>9</b>
<b>Total personnels</b>	<b>25</b>

## EVALUATION

### Overall assessment of the team

The Geophysical Fluid Dynamics team carries out research that falls within all four of the IPGP's research themes and this is reflected in a significant degree of interaction and scientific collaboration with other teams. Linked to this is a certain lack of clear identity for the group in itself, distinguishing it from other teams that cover explicitly similar topics. What remains is experimental fluid dynamics, with its impressive IPGP historic pedigree and the raison d'être of its initial establishment, which remains an important part of the activities of the group as a whole.

## Strengths and possibilities linked to the context

Numerical modelling – encompassing several different approaches – is widely applied and technical, and computational support for numerical modelling is also a highlight of the team's activities. A number of high-impact publications involving numerical analysis of important Earth processes (at a variety of scales, including at the scale of the magnetic-hydrodynamics of the Earth's core) is reported.

## Weaknesses and risks linked to the context

Scientific production is reported to be 2 publications per year per permanent staff member. This number, which, of course, has to be seen in the context of 'degree of difficulty' of experimental work compared to some other methodologies, seems rather modest, especially given the amount of collaboration with other groups that is involved, and therefore the possibility of publishing more thanks to the dynamic created with these groups.

The space and specialised laboratory equipment devoted to experimental fluid dynamics are the subject of a major investment that is over-dimensioned in relation to the group's research activities.

## Analysis of the team's trajectory

The trajectory of the team is expressed in terms of using tractable modelling set-ups of process-orientated targets as a way of predicting and isolating specific phenomena that can then be further investigated or tested by observational campaigns. This is a highly attractive conception of how the physics of the Earth can and should be examined and implies a significant role for quantitative methods. This is similar to how many if not most of the research teams are operating, this being good scientific practice, and it has driven good collaborative projects with other teams.

Given the enormous advances in numerical modelling techniques and capabilities in the last decade, and the team's own successful investment already made and plans for future expansion of activities in the realm of numerical modelling, 'trajectory' in this direction is to be welcomed. There also remain valuable insights to be gained in the realm of analogue modelling, especially in regimes not easily accessible to numerical simulations.

The portfolio items named by the team are almost all on topics that fit very comfortably within other teams and are not obviously limited to geological fluid dynamics in the first instance. This is possibly a good indication of cross-team interaction and integration of methodologies, which can generally be considered to be positive, but it also questions the integrity of the GFD team as a separate entity within the institute.

## RECOMMENDATIONS TO THE TEAM

Consolidation of research strategies to produce a more coherent research group could be considered. Another possibility could be to disperse the team within the other teams of geomagnetics, volcanics, hazards, etc., including possibly 'big data'. This suggests the creation of an integrated geomodelling (numerical and analogue, possibly some 'simulation' and display initiatives as well) node at IPGP, allowing further consolidation of expertise, technical support and facilities.

**Team 7:** Geomagnetism  
 Name of the supervisor: Mr Thomas Gastine

## THEMES OF THE TEAM

The core of the research activity of the team is in connection with two of the IPGP Themes (Earth and planetary interiors, Natural hazard) and is mainly developed along three axes:

1) Acquiring and analysing modern magnetic (and related) data, interpreting geomagnetic data (and other data such as geodetic data), 2) producing magnetic field models and predicting the future morphology of the main field, resorting to data assimilation, and 3) carrying out direct numerical simulations to model and characterise the internal dynamics of the core (convection, dynamo process). Most of the scientific activity is focussed on Earth but team members regularly expand their field of research beyond pure geomagnetism, for instance with regular contributions to the study of planetary magnetic fields.

## CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

Recruitment difficulties (recommendations of the previous report) are well identified 'to improve the recruitment of Early Career Researchers (both postdocs and PhD students)' but persist despite the team's efforts.

## WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	3
Maîtres de conférences et assimilés	1
Directeurs de recherche et assimilés	1
Chargés de recherche et assimilés	1
Personnels d'appui à la recherche	0
<b>Sous-total personnels permanents en activité</b>	<b>6</b>
Enseignants-chercheurs et chercheurs non permanents et assimilés	2
Personnels d'appui non permanents	3
Post-doctorants	0
Doctorants	1
<b>Sous-total personnels non permanents en activité</b>	<b>6</b>
<b>Total personnels</b>	<b>12</b>

## EVALUATION

### Overall assessment of the team

The team is very dynamic, with a high level of involvement in IPGP management despite its limited membership. Focusing on magnetic data and their quantitative interpretation, the team has a very clear vision of its objectives, enabling it to play a major role in its field. Its scientific production is first-rate.

### Strengths and possibilities linked to the context

The team is heavily involved in, and often at the origin of, major space observation projects. It is also renowned for its interpretation of terrestrial and space data and modelling of various contributions to the magnetic field. In particular, the next solar cycle maximum will enable advances in space weather, and the opportunity to

contribute to the next generation International Geomagnetic Reference Field. The recent and forthcoming launches of new satellites to observe the Earth's magnetic field open up great prospects. Terrestrial dynamo and global geodynamics remain highly productive areas.

### Weaknesses and risks linked to the context

With 6 permanent researchers, largely involved in the management of the institute, technical aspects, the observatory and teaching, the room for manoeuvre is limited (even though all of them will still be active for a longer period than the next contract). As far as technical support for research is concerned, the problem is immediately critical following the departure of the engineers in charge of satellite magnetometers, spatial data management and computing resources. Current temporary funding does not guarantee the sustainability of the activity.

### Analysis of the team's trajectory

The objectives are very convincing and achievable, provided that the team can attract new talent and that technical support is guaranteed.

## RECOMMENDATIONS TO THE TEAM

The team represents a pole of excellence in the field of geomagnetism. It must continue on this trajectory. It needs to be strengthened if it is to remain at this level in the medium term.

The team should consider options in case the NanoMagSat mission (Constellation of 'Cubesats' with magnetometers, program SCOUT of ESA) does not get approved, including forming a strategy to get involved in ongoing or future planetary space missions to other solar system bodies.

**Team 8:** Geomaterials  
 Name of the supervisor: M. Daniel Neuville

## THEMES OF THE TEAM

The Geomaterials team studies the physical properties and structure of Earth materials, crystals, liquids, glasses, and magmas. It has developed tools to link the structure at high temperatures to macroscopic properties such as viscosity. The work of the team has applications in fundamental earth sciences but also in applied materials sciences, with strong industrial implications, specifically in the energy transition domain.

## CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The recommendation on the scientific activity was to continue the excellent production, which is still excellent. The strong recommendation on the scientific strategy and project was to join another team of IPGP, which has not been done.

## WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	0
Maîtres de conférences et assimilés	0
Directeurs de recherche et assimilés	1
Chargés de recherche et assimilés	0
Personnels d'appui à la recherche	0
<b>Sous-total personnels permanents en activité</b>	<b>1</b>
Enseignants-chercheurs et chercheurs non permanents et assimilés	1
Personnels d'appui non permanents	0
Post-doctorants	0
Doctorants	2
<b>Sous-total personnels non permanents en activité</b>	<b>3</b>
<b>Total personnels</b>	<b>4</b>

## EVALUATION

### Overall assessment of the team

The team Geomaterials provide an excellent scientific record with 89 publications. The actual size of the team is unclear with one DR and an associated CEA-DR at 20%. With one permanent researcher, a rate of more than twelve publications/ETP/year is exceptional in the field of earth sciences (may be biased by the small number of ETP). The team develops new thematics with strong industrial and societal applications, specifically in energy transition and medical domains. The size of the team remains a very weak point, as strongly underlined by the previous committee.

### Strengths and possibilities linked to the context

The team Geomaterials provide a very efficient scientific work, merging both fundamental and applied research. Moreover, the publication record of the team is exceptional in the overall earth sciences domain. The strengths of the team rely on its own specific expertise on glass' physics, and on its strong collaboration and

international scientific network, which allow such an activity. The most obvious opportunity for the team appears to be its links with rising industrial matter related to glasses, particularly within the framework of renewable energy.

## Weaknesses and risks linked to the context

Obviously, as already underlined in the previous Hcéres report, but also recognised in the self-assessment report of the team, its major weakness is the very small size of the team, with only one permanent researcher. This threatens its viability at middle term and weakens its visibility at the local and national levels. Among other problems that can stem from the small size of the team is the lack of scientific animation and integration, in particular for young and early career researchers. Participation to the themes of the laboratory may help but will not solve this.

## Analysis of the team's trajectory

From a scientific viewpoint, the team trajectory is in the continuity of its current projects, with a will to develop the industrial application and relationships. From a human resources viewpoint, the single strategy presented in the report is to hire a CNRS colleague, which appears to be a long-term, fragile strategy. Organising inter-team meetings as proposed in the trajectory seems a limited action with respect to the situation of the critical size of the team.

## RECOMMENDATIONS TO THE TEAM

The committee has the same main recommendation as the previous committee, which is to merge the Geomaterials team with a larger one within the IPGP scheme. This matter should be discussed and negotiated with the IPGP direction and the potential implicated teams. This appears to be the sole solution to reinforce the scientific scopes of the team in the laboratory, which is absolutely crucial as the team's medium-term survival is threatened.

If this cannot be done, the committee recommends giving a specific attention to the integration of the team's young researchers (postdocs, PhD candidates) in the lab's scientific life, so as to make sure they benefit from many interlocutors and collective activities, outside of the team itself.

The committee recommends continuing the excellent research led by the team, particularly focusing on scientific production, editorial activity, and addressing societal problems.

**Team 9:** Geomicrobiology  
 Name of the supervisor: Mr. Alexandre Gélabert

## THEMES OF THE TEAM

The Geomicrobiology group focuses on studying the interactions between microorganisms and minerals, as well as identifying and characterising organic molecules that have an abiotic or biological origin. The Geomicrobiology group is highly interdisciplinary since it combines a wide range of expertise in microbial ecology, bioinformatics, isotope biogeochemistry, and mineralogy/petrology. The significant reorganisation of the group following several departures and arrivals has not prevented it from maintaining its scientific output and impressive success in collecting funds (2.6M€/year) from a multitude of calls for proposals. The scientific animation is dynamic inside the team and in the theme Origins.

## CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The overall assessment was excellent, and no precise recommendations were made except '*more interactions with other teams, especially through the theme "Origins"*'. While the life of the theme Origins clearly shows closer ties with other IPGP teams, this is not reflected in joint publications.

## WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	1
Maîtres de conférences et assimilés	2
Directeurs de recherche et assimilés	0
Chargés de recherche et assimilés	1
Personnels d'appui à la recherche	4
<b>Sous-total personnels permanents en activité</b>	<b>8</b>
Enseignants-chercheurs et chercheurs non permanents et assimilés	3
Personnels d'appui non permanents	0
Post-doctorants	0
Doctorants	4
<b>Sous-total personnels non permanents en activité</b>	<b>7</b>
<b>Total personnels</b>	<b>15</b>

## EVALUATION

### Overall assessment of the team

The Geomicrobiology group is developing an interdisciplinary research activity aimed at distinguishing between microbiological and purely abiotic transformations within rocks. In doing so, it works on aspects as diverse as organism-mineral interactions and abiotic reactions that generate organic molecules. This unique research activity shows an unprecedented level of scientific quality and ensures the team national and international recognition with a unique place in the field of 'The origin of Life'.

### Strengths and possibilities linked to the context

The group is rapidly growing thanks to the recruitment of 1 CR and 2 MCF, and 4 IPGP internal movements, partially counterbalanced by 2 departures. This provides a greater striking power that, together with the three



PEPR (programmes et équipements prioritaires de recherche in french) in which the team takes part, should boost the attractiveness of the team. Over the period, the Geomicrobiology Group has authored 137 publications in international, peer-reviewed journals, corresponding to an average of 4.0 publications FTE/year.

### Weaknesses and risks linked to the context

The team develops a biological approach that has no equivalent in the laboratory and which rests on the shoulders of just one person. The fact that this person has taken over the management of the team while the biological research activity is expanding within the team is a definite risk to the maintenance of this approach. It is essential to recruit a biologist.

### Analysis of the team's trajectory

The exposed trajectory clearly places the understanding of the interactions between microorganisms and minerals at the heart of the project of the team now entitled 'Lithosphere, Organosphere and Microbiosphere', with funding already secured, allowing the following of this trajectory realistic.

## RECOMMENDATIONS TO THE TEAM

The committee encourages the Geomicrobiology group to pursue its innovative and interdisciplinary research. The committee recommends the team develop internal collaborations that go beyond simply leading the cross-disciplinary theme Origins.

**Team 10:** Marine Geosciences  
 Name of the supervisor: Ms Nathalie Feuillet

## THEMES OF THE TEAM

The research of the Marine Geosciences team is strongly reliant on seagoing expeditions for data and sample collection and the team is, as such, a prime provider as well as the end user of shared marine data and observations internationally. Besides the enormous analytical and modelling role this implies, the team's theme also comprises a key component of geophysical observatories, data collection and even curation.

## CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

Recommendations of the previous report were all exemplary in nature, stressing the successes demonstrated by the team and providing encouragement on how to maintain these. It was recommended that the workflow of the team's engineers and technicians might be streamlined in the context of home-based and sea-based activities. In this regard there has been additional integration of engineers and technical staff and new engineers have been hired.

## WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	2
Maîtres de conférences et assimilés	5
Directeurs de recherche et assimilés	3
Chargés de recherche et assimilés	2
Personnels d'appui à la recherche	6
<b>Sous-total personnels permanents en activité</b>	<b>18</b>
Enseignants-chercheurs et chercheurs non permanents et assimilés	0
Personnels d'appui non permanents	4
Post-doctorants	4
Doctorants	6
<b>Sous-total personnels non permanents en activité</b>	<b>14</b>
<b>Total personnels</b>	<b>32</b>

## EVALUATION

### Overall assessment of the team

The team is one of the main end users of shared marine data and direct observations on French marine territories (Antilles, Mayotte), complementing other regional studies. It is one of the largest and most active teams at IPGP. Consistently, it exhibits strong overall attractiveness, both for new researchers, postdocs, PhD students, ITAs, and for instrumental developments (produced by a part of the team based in Chambon-la-Forêt).

The team is highly competitive at both national and international levels in the field of marine geosciences. It has numerous international interactions, meetings, and workshops that contribute to remarkable international visibility (publications, awards, conference, or workshop organisation). Additionally, it often leads oceanographic campaigns, being very active in their organisation and in seeking public or private funding.

The team has a clear understanding of future challenges and has proposed an evaluation of its CO2 footprint for the future. It is also very attentive to its aging and gender equality evolution.

## Strengths and possibilities linked to the context

The team delivers abundant excellent scientific research results at the high end of international science. The team has exceptional international visibility, which enhances its attractiveness to young researchers, including new hires and a diverse cohort of postdoctoral fellows and students as well as to more senior visiting scientists. There are active involvement and leadership roles with national networks, scientific initiatives, conferences, and workshops. The team has concomitant high success rates with funding from national and international sources, private and public and, accordingly, possesses an outstanding publication record demonstrating its high impact in global marine geosciences. The team is directly involved in developing new instrumentation as part of its research goals and has played a significant role in societally relevant actions such as the management of the Mayotte crisis.

## Weaknesses and risks linked to the context

There are programme difficulties that uniquely impact this team related to marine data acquisition, exacerbated by rising energy costs and the built-in delay between project construction and its ultimate realisation.

## Analysis of the team's trajectory

The team has given explicit attention to website improvement and enhanced attention to issues pertaining to CO<sub>2</sub> footprint in its interactions with industry and private companies. Outreach activities are now explicitly part of the team objectives together with the website update. Research ambitions for the team's future are plausible and strategically well thought out with a clearly defined intention to develop new directions that work in synergy with existing activities rather than making new, potentially isolated initiatives, which seems to be the case for several other teams.

## RECOMMENDATIONS TO THE TEAM

It is recommended that the unique threats affecting this team (mentioned above) are to be mitigated as fully as possible in order to allow it to continue as a centre of excellence for marine geosciences. The team expressed some concerns regarding an increase in responsibilities for active observatories and institutional support should be adjusted in order to ensure that the team's impressive research outcomes are not negatively impacted. Regarding observatories additional technical capabilities are required. Further, the team is one of few considering the CO<sub>2</sub> footprint on its activities and this a notable effort that should keep being a priority, given the instrumentation needs, and private partners.

**Team 11:** Paleomagnetism  
 Name of the supervisor: Mr Frédéric Fluteau

## THEMES OF THE TEAM

The Paleomagnetism team is one of IPGP's founding groups, continuously involved in studies of the geomagnetic field and its evolution in intensity and geometry over all geological timescales, tectonic plate reconstruction, and lithospheric deformation, which represent its original themes. The team had a pioneering role in archaeomagnetism. Since the end of the 1990s, the team has been developing studies of pre-Quaternary climate changes and mass extinctions. Its expertise in fundamental rock magnetism has made possible the development of environmental magnetism research focusing on continental climate and paleoenvironmental changes, and more recently, on anthropogenic pollution.

## CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The recommendations of the last Hcéres report were:

'The team must keep going with excellent level of researches but a better identification of priorities would be appreciated.'

'The level of interactions between the team members could be improved.'

'The strategy for the sustainability of this team is not guaranteed at a longer term given the (too) large scope of research and the future retirements of some of the leaders in this field.'

'This team has a strong specificity in France and an international leadership that should be preserved as much as possible. The expert committee does not want to recommend one well-defined action, but wants to alert that an urgent action is needed whatever the way to do it. For instance, how to mutualise engineers to provide more help to this team? What would be the benefit (or lack of benefit) to merge with geomagnetism? How to attract young people in this field? '

The team has noticeably evolved since the last evaluation, with the recruitment of three new permanent members, alongside two retirements. Interactions within the team appear to be improving. However, the issue of the amount of research scopes remains a risk for this team, particularly concerning its workforce and the impending retirements at mid-term, especially in the field of archaeomagnetism. The question of regrouping with the geomagnetism team is still open, as the two teams share many interests and research scopes.

## WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	1
Maîtres de conférences et assimilés	3
Directeurs de recherche et assimilés	3
Chargés de recherche et assimilés	2
Personnels d'appui à la recherche	1
<b>Sous-total personnels permanents en activité</b>	<b>10</b>
Enseignants-chercheurs et chercheurs non permanents et assimilés	3
Personnels d'appui non permanents	1
Post-doctorants	0
Doctorants	1
<b>Sous-total personnels non permanents en activité</b>	<b>5</b>
<b>Total personnels</b>	<b>15</b>

## EVALUATION

### Overall assessment of the team

The scientific production is excellent with a high publication rate and international recognition, bolstered by unique instrumental facilities, despite challenges in securing external funding. Its societal contributions are of first importance. Future research will focus on geomagnetic field behaviour, plate reconstruction, and paleoclimate modelling, with a promising trajectory in paleoclimatology. The team should further explore collaboration opportunities, address funding challenges, and strengthen support personnel, which is a weak point. Maintaining in-person interactions with respect to remote work is also very important. Overall, the team's trajectory is promising, but some strategic adjustments would allow mitigating risks and sustain its excellence.

### Strengths and possibilities linked to the context

The team demonstrates an excellent production in the field, including a very good publication rate (4.3/FTE/year), 152 on the period for the team. The team's expertise is internationally recognised. The team attracts invited researchers nationally and internationally. The team develops research with strong implications in terms of climate and environmental change, which is a cutting-edge thematic for the future. Part of this attractiveness also resides in a unique pool of instrumental facilities. The hiring of an engineer during the period allowed restarting instrumental developments. The size of the team is a good one to develop an efficient team-life and collaborative projects. Moreover, the team was able to hire new junior researchers during the period, which reflects its rising trajectory. The team research activities bring useful contributions to society, as demonstrated for instance in the EcorcAir project.

### Weaknesses and risks linked to the context

The team is experiencing difficulties in obtaining external competitive funding (ANR), which is somewhat perplexing given the excellent level of the team and its thematic focus strongly connected with societal issues. The weakness in support (IE/IR/Tech), with only one IE to maintain a large instrumental pool, along with a medium-term problem regarding the continuity of activities in the Chambon la Forêt campus, which would necessitate a technician, represents a risk to the team's activities. The cost and time-consuming maintenance of the platform could also pose a threat to maintaining scientific productivity at a high level and external collaborations. A specific threat is the reliance on archeomagnetism expertise, which is dependent on a single senior member of the team. This risk could be mitigated by the skills required for this thematic, which are quite similar to those for high-resolution paleomagnetism already present in the team. Given the geopolitical context, the strong collaboration with Russian institutions may be seen as a potential threat that requires analysis. The COVID-19 crisis has significantly impacted team dynamics, with more individuals working from home, which could hinder day-to-day interactions. While the research topics within the team align with several themes, the team's contribution to these themes appears to be nonexistent.

### Analysis of the team's trajectory

The overall team trajectory remains clearly in the continuity of its current activity, focusing on the following three main research fields: geomagnetic field, geodynamics, and paleoclimate. The team does not plan to develop new domains, but, in fact, it is already at the cutting edge of their research at the international level.

Concerning the geomagnetic field, the team will continue to develop cutting-edge research on paleomagnetic and magnetostratigraphic analysis, focusing on geomagnetic field behaviour across the different time-scales. The team projects to construct regional and global geomagnetic field models, utilising refined archaeomagnetic datasets and contributing to archaeomagnetic dating in collaboration with archaeologists. This last point will depend on the capacity of the team to stabilise the archeomagnetism thematic.

Concerning the geodynamic field, the team's research will concentrate on Neoproterozoic plate reconstruction, exploring environmental changes across the cryosphere, biosphere, atmosphere, and oceans. The study of supercontinent cycles, mantle dynamics, and true polar wander, will allow uncovering long-term plate tectonic processes, addressing complexities in the Neoproterozoic paleomagnetic signal. This trajectory is fully in the continuity of the ongoing core research of the team.

Concerning paleoclimate, the team's trajectory focuses on climate modelling and environmental magnetism. Simulating the Early Earth's climate evolution by combining biogeochemical cycles and isotopic ratios would be a key point in our knowledge of past climates. The team proposes to work on the impact of volcanic gases on ocean biodiversity and related mass extinctions. It will also focus on better characterising climatic variability in the Cenozoic and Quaternary loess to understand past atmospheric circulation. Finally, the team will continue

its emerging thematic on urban pollution using magnetic properties for nanoparticles. The thematic on paleoclimate in general is very promising for the team as a whole.

## RECOMMENDATIONS TO THE TEAM

The committee recommends continuing the excellent scientific output of the team, with a special focus on the paleoclimatology theme, which may become the most important research domain in the future. Collaboration with the geomagnetic team should be developed within a more established framework, possibly considering a merger due to shared scientific interests and tools. A thorough consideration is needed for the future of the archaeomagnetic theme, which provides significant visibility but faces a risk of discontinuation in the midterm. Regarding ANR and competitive funding, the team should continue regularly submitting projects and organise a dedicated review to address the low success rate in these calls. The team members who work remotely on a regular basis should make sure to spend enough time in the lab to keep in-person interactions. Special attention should be given to support personnel (PAR), with plans to reinforce them in the coming years.

**Team 12:** Physics of natural sites  
 Name of the supervisor: Mr Frédéric Girault

## THEMES OF THE TEAM

The main research theme of the team is the hydrothermal system and processes in the context of active tectonics, with side implications on contaminants and volcanic hazards.

## CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The previous report stressed the need to make a choice about the team's future, and to tailor the support to that choice. Although the situation has not evolved formally to date, the expected change was acted upon during this visit by the team's last researcher.

## WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	1
Maîtres de conférences et assimilés	1
Directeurs de recherche et assimilés	0
Chargés de recherche et assimilés	0
Personnels d'appui à la recherche	0
<b>Sous-total personnels permanents en activité</b>	<b>2</b>
Enseignants-chercheurs et chercheurs non permanents et assimilés	0
Personnels d'appui non permanents	0
Post-doctorants	0
Doctorants	0
<b>Sous-total personnels non permanents en activité</b>	<b>0</b>
<b>Total personnels</b>	<b>2</b>

## EVALUATION

### Overall assessment of the team

The small size of the team has already been pointed to 5 years ago with two permanent researchers. Now, only one is active and the size of the team is critical enough to be an issue for both the research projects and the interaction with other teams.

### Strengths and possibilities linked to the context

The team has skills on field data sampling and instrumentation, and analytical measurements. On one principal field area, Nepal, strong cooperation has been established and projects are ongoing even after the Covid Crisis impact.

Interactions with an international Master program encourages students to apply for internships and train on the team's projects and themes.

Active interactions with IPGP teams should ease the left team members to join another team and accordingly given the low probability of recruitment, the remaining member is considering joining another team within a time frame of one year (before 2025).

The team's equipment was managed by the team members and from 2022 by a new technician, still recent for a new integration in another team.

### Weaknesses and risks linked to the context

One of the two team-permanent members retired. The team can no longer be considered as a team with only one researcher.

The scientific rationale for the independent existence of this team was not clear from the beginning as stated by the previous Hcéres report but with only one member of the team doesn't justify as an independent entity anymore. Its tiny size does not help the administration simplification needed by the IGP grand établissement as stated earlier in the report.

### Analysis of the team's trajectory

The team attracts Master, PhDs and postdoctoral students, but has not been able to recruit in the last 5 years.

The team applied for several competitive calls (ERC, ANR, FCT, Labex, PHC, INSU) but, except a Labex (210 keuros) met with success only for <10k€ projects and for 20% of their funding on recurrent funding. Nonetheless successes are numerous in participating or co-leading other projects since the last 5 years.

## RECOMMENDATIONS TO THE TEAM

The most important objective is clearly pointed out by the permanent researcher to merge with another team within twelve months. The committee supports this approach. Two teams are potentially able to integrate Natural Sites personal. Such new interactions should sustain new applications for funding, PhD projects and further developments both for the instrumental and theoretical parts of the projects, either in Nepal or on the volcanic targets of the last researcher.



**Team 13:** Planetology and space sciences (PSS)  
 Name of the supervisor: Mr Sébastien Rodriguez

## THEMES OF THE TEAM

The team is focused on studies of mainly telluric planets, and marginally small bodies, including terrestrial seismology and remote sensing of planetary atmospheres and surfaces, and ionospheric studies.

## CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

Since the last evaluation, the team has 'reinforce existing skills' (recommendation of the previous report) with development of new partnerships in UPCité in the frame of the UPCité Space Facility, and more specifically with the other space laboratory of the university, APC. They also developed new collaborations (with co-supervised PhDs) with two other teams of IPGP, DFG and CAGE

## WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	3
Maîtres de conférences et assimilés	2
Directeurs de recherche et assimilés	0
Chargés de recherche et assimilés	4
Personnels d'appui à la recherche	5
<b>Sous-total personnels permanents en activité</b>	<b>14</b>
Enseignants-chercheurs et chercheurs non permanents et assimilés	1
Personnels d'appui non permanents	4
Post-doctorants	0
Doctorants	11
<b>Sous-total personnels non permanents en activité</b>	<b>16</b>
<b>Total personnels</b>	<b>30</b>

## EVALUATION

### Overall assessment of the team

PSS is a very fruitful team that makes outstanding contributions to the development of highly advanced TRL instruments but also in significant PI-ship of space missions. The team is also hosting support for numerical modelling related to this instrumentation by activities related to geophysical modelling of the internal structure of telluric bodies, remote sensing, and ionospheric models. New collaborations at the UP Cité level have been set up and more interactions with IPGP teams must strengthen and develop.

### Strengths and possibilities linked to the context

PSS hosts worldwide leaders in the domain of planetary seismology. The team expertise in the construction of the SEIS seismometer of the InSight mission (Cnes/ESA/NASA) is internationally acknowledged and the important number of high-impact publications and awards obtained by the group is a clear indication of such a recognition. The success of the InSight mission opens the doors to new projects with high potential, especially in the context of the NASA/ESA return to the Moon with the Artemis missions. The seismology activity aligns well with

other strengths of the team, especially theoretical expertise in geophysical modelling of planetary internal structure. In addition, although with a slightly lower profile, the team's work on remote sensing of Earth and other solar system objects is of very high quality. These different aspects of the team are well identified and scientifically recognised and give clear opportunities for collaborations with other teams such as Geodesy, GFC or CAGE.

### Weaknesses and risks linked to the context

The involvement of the team in leading-edge instrumentation for space agencies is the key driver for the team's evolution. The stresses and constraints imposed by space agencies for such developments can be quite demanding for researchers and engineers, especially when few permanent people are involved.

The retirement of the InSight PI in the five coming years is also a real risk for the team if no clear strategy is set up to address its impact.

### Analysis of the team's trajectory

At the science level, the trajectory of the team is aligned with the outstanding level of the past and present activities of the group. The move of the team to the Cuvier site will also be an opportunity to continue and strengthen the collaboration with other teams such as CAGE, GFS but also Geodesy.

At the institutional level, the team has started to set up a favourable environment at the UPCité with its new collaboration with APC.

## RECOMMENDATIONS TO THE TEAM

The team must continue to produce outstanding science and leading-edge instruments. It should also continue to find new opportunities to strength its instrumental activities by setting up new collaboration at the UPCité level. It should work on developing its collaborations with other teams.

The team should take into account for their strategy during the next future the retirement of one head member.

**Team 14:** Seismology  
 Name of the supervisor: Mr Jean-Philippe Metaxian

## THEMES OF THE TEAM

The team covers almost all aspects of seismology. It has expertise in instrumentation and instrumental development. It develops activity in the study of volcano structures and dynamics. The team studies seismic sources and ground motion including hazard assessment. A more recent development concerns environmental seismology.

## CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The previous report concluded that the number of scientific challenges was high compared to the number of active researchers and suggested implementing a strong recruitment policy combined with encouragement for more female candidates. With four newcomers to the team, it seems that the recommendation has been followed. However, only one of four new researchers is a female.

## WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	5
Maîtres de conférences et assimilés	3
Directeurs de recherche et assimilés	2
Chargés de recherche et assimilés	1
Personnels d'appui à la recherche	3
<b>Sous-total personnels permanents en activité</b>	<b>14</b>
Enseignants-chercheurs et chercheurs non permanents et assimilés	3
Personnels d'appui non permanents	0
Post-doctorants	1
Doctorants	7
<b>Sous-total personnels non permanents en activité</b>	<b>11</b>
<b>Total personnels</b>	<b>25</b>

## EVALUATION

### Overall assessment of the team

The team has a strong image established over the years. Scientific activity and production are excellent. The strong components that have made the group's reputation are closely linked to the imaging of structures, particularly deep structures, and to the mechanics of earthquakes and slope instabilities. These are subjects that are directly linked to several of IGP's general themes and ensure that seismology is integrated into the whole.

The team has also been successfully involved in recent seismological developments (use of continuous data, new optical sensors, gravimetry).

The quality of the team's research is attested by numerous publications and by international awards.

Some of the team's researchers are based at the Observatory on Reunion Island, which makes scientific contacts difficult.

## Strengths and possibilities linked to the context

The team's broad spectrum of skills is a hallmark of quality and enables rapid adaptation. It has numerous collaborations and participates actively in major national and international initiatives in seismology, such as EPOS.

The team has outstanding expertise in the study of earthquakes using long-period seismological data on the one hand, and in the joint use of gravimetric measurements on the other.

The team has successfully begun to compensate for the recent and forthcoming departures of key figures with the recruitment of promising young researchers.

Through its new recruits, it is developing its involvement in volcanological observatories, a rich source of data that opens the way to studies of the influence of fluids on seismicity, which could be extended to faults.

The team is equipped with its own set of sensors.

The team has demonstrated its opportunism about new metrological developments, such as deformation measurements using optical fibres. It also took part in analyses of the prospects opened up by new rotation sensors.

## Weaknesses and risks linked to the context

Some historical themes seem to be weakening. This is the case of deep structure studies, which no longer play the central role they did a few years ago. Yet this is an important element for the place of seismology in the 'Earth and planetary interiors' theme. We could also mention earthquake dynamics. For these themes, three leading researchers have retired or will be leaving shortly. Similarly, we can also question the themes of numerical simulation and fracture dynamics.

A large number of simultaneous themes is undoubtedly a mark of individual dynamism, but there is a risk of losing cohesion.

The team is facing problems of lack of technical support that could rapidly become critical with the fast growing of the data sets to archive and process, especially with DAS (Distributed Acoustic Sensing) development.

## Analysis of the team's trajectory

The list of objects to be studied and techniques to be developed is not very hierarchical.

There are many items described, including seismic imaging at all scales, seismic source dynamics, artificial intelligence, applications to landslides, glaciers and volcanoes, and urban seismology.

The specific section 'Projects over the next 5 years' focuses on metrology. The aim is 'to be a national leader in the DAS technology', plus some projects on neutrino imaging and on future Moon data.

Three of the recruitment targets indicate replacements for traditional themes, somewhat at odds with the announced projects.

Given the ambitious project of developing further DAS processing, it would be interesting to estimate the carbon footprint of such technologies in regards to the expected benefits.

## RECOMMENDATIONS TO THE TEAM

Scientific bets are welcome, but the team has to be cautious about the real benefits of emerging instruments. At the very least, it is important to preserve the team's excellent position in the use of data of proven quality.

The committee encourages the efforts to maintain research lines that are in synergy with the dynamic of the whole IGP with deep-earth studies.

It would be advisable to maintain a strong competence in numerical simulation of wave propagation, inversion and rupture dynamics, subjects that will remain central to the development of seismology.

The team must retain its ability to deploy on major projects that would offer opportunities for synergies between team members.

**Team 15:** Stable Isotope Geochemistry (SIG)  
 Name of the supervisor: Ms Magali Ader

## THEMES OF THE TEAM

The Stable Isotope Geochemistry team (SIG) aims at understanding the Earth's origin and dynamic using the isotopic ratios of stable elements such as S, C, H, O, N and Cl. The team relies on a strong analytical background and on a combination of isotopic tracers to tackle a large range of processes, from planetary formation to the anthropogenic impact on the environment covering the 4 themes of the IPGP.

## CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The previous committee recommended that the team take more care about the PhD student scientific production. This recommendation has been followed as, in the evaluated period, postdocs and PhD students first authored around 25% of the total number of publications of the team.

Other recommendations to preserve the team's identity and to stay focused on some important subjects have been partly followed. The SIG team successfully kept its strong identity based on the development of new techniques and stable isotopes approach for studying a large range of geological and environmental processes. The thematic diversity is not seen as problematic as it was a few years ago and reflects the adaptability of the team to emerging environmental problems (e.g. CH<sub>4</sub> fingerprinting, H<sub>2</sub> economy).

## WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	3
Maîtres de conférences et assimilés	2
Directeurs de recherche et assimilés	2
Chargés de recherche et assimilés	2
Personnels d'appui à la recherche	6
<b>Sous-total personnels permanents en activité</b>	<b>15</b>
Enseignants-chercheurs et chercheurs non permanents et assimilés	2
Personnels d'appui non permanents	0
Post-doctorants	0
Doctorants	3
<b>Sous-total personnels non permanents en activité</b>	<b>5</b>
<b>Total personnels</b>	<b>20</b>

## EVALUATION

### Overall assessment of the team

The team has a strong identity and a nationally- and internationally recognised expertise in stable isotopes geochemistry. Team members are working on a wide range of topics, with a clear commitment to developing innovative research activities thanks to its strong involvement in analysis and analytical development (9 mass spectrometers and 10 vacuum lines). The team's scientific output is high, with 163 publications, and its contribution to the development of 'clumped isotopes' in several molecules provides an impressive attractiveness that extends beyond the IPGP. With nearly 80% of team members holding an HDR, the team is committed to training young researchers (8 PhD defended or in progress and 3 postdocs). The team's attractiveness is demonstrated by successes in national (3 ANR as PI) and European (1 ETN) calls for projects,

by visits from foreign professors, and by collaborations with EPICs (CEA, IFPEN, BRGM) and industrial partners (SLB, TotalEnergies) on resources- or societal-related projects.

## Strengths and possibilities linked to the context

The SIG team has a very high visibility, due in particular to its expertise in the field of mass spectrometry of 'classic' (SCHON) or rare stable isotopes (CI), the combination of which makes it possible to address a wide range of Environmental and Earth Sciences-related topics. Its involvement in emerging fields (clumped isotopes, isotope fractionation associated with bio-physico-chemical processes), in the development of new analytical techniques (high-resolution mass spectrometer) and in the building and running of the ETN Saltgiant, a cross-disciplinary network with partners from 7 different countries, has raised further its international visibility. The team's attractiveness is also underpinned by strong analytical skills and a remarkable array of laboratory instruments, including original equipment developed and perfected within the team.

Relative to its size, the GIS team develops a substantial number of national (6 ANR) and European (1 ETN) research projects, as well as partnership contracts (4) with the socio-economic environment (Total, Schlumberger). The invoicing of analyses to members of other IPGP teams or to external members also helps to diversify funding sources. The team's scientific output is very good, with a notable increase over the last contract (from 92 articles and book chapters to 163), which testifies to the team's strong impetus. The number of members holding an HDR is also increasing (2 more).

## Weaknesses and risks linked to the context

The research activities carried out by team members cover a wide range of topics. It concerns 1) mantle-atmosphere interactions, to the cycle of elements, in the mantle, 2) the reconstruction of paleoenvironments, including the search for modern analogues to Precambrian environments, 3) the study of bio-physical-chemical processes and their impact on nano-technology and biomedical applications, not forgetting 3) topics related to geo-energy and nuclear sciences. Although this is not necessarily a drawback, there is a real risk of fragmentation in the thematic research carried out by the team.

The cost of running the analytical instrument park is high, and is not fully covered by yearly funding. This represents a risk for the team's research activity should be funding sources other than basic support decrease. The MAT253 mass spectrometer is aging, and its failure could pose a significant problem if it is not replaced in the coming years.

The team will suffer from a negative demographic trend with the planned departure of a technical staff member. Although the number of technical staff is still significant, the high number of instruments implies a heavy workload for this technical staff, which could become critical to maintain a high level of research activity for the team.

## Analysis of the team's trajectory

For the next contract, SIG plans to continue investing in the development of emerging tracers and in the coupling of conventional tracers. The maturity of the project to develop a high-resolution mass spectrometer opens up extremely innovative opportunities for the study of natural hydrogen production as part of multidisciplinary collaborations with geobiologists or industrial partners (SLB), or as part of cosmochemical studies on the isotopic composition of sulfur (ANR 'Young Researchers' (JCJC -Jeunes Chercheuses et Jeunes Chercheurs in french). Team members' expertise in the field of clumped isotopes is also a highly promising area of research, particularly in the reconstitution of paleoenvironments and the study of climate-environment transitions, thanks to their active involvement in major multidisciplinary international projects (IODP and ICDP projects). In parallel with these major international projects, the team plans to strengthen the research synergy between team members involved in research activities related to volcanological observatories in Martinique, Guadeloupe or Mayotte, so as to encourage exchanges and the emergence of joint projects enabling greater cohesion within the team.

## RECOMMENDATIONS TO THE TEAM

The committee recommends that the team keeps publishing in particular through a strong PhD students' scientific production.

It encourages the implementation of a strategy to offset the departure of certain members of the technical staff.

The rejuvenation of the MAT253 mass spectrometer should be planned in the short term to ensure the development of dual D47-D48 analyses, which presently relies on a fifteen-year-old mass spectrometer.

**Team 16:** Tectonics and mechanics of the lithosphere  
 Name of the supervisor: Mr Yann Klinger

## THEMES OF THE TEAM

The research topics of the team encompass the deformation of the continental lithosphere from short-time scale processes (e.g., earthquakes) to long-term contractional deformation leading to mountain building. The methodologies used cover a broad spectrum from field observations to satellite imagery and landscape evolution modelling.

## CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The previous report recommended further developing interaction with society through production of informative material for public dissemination and this has been taken into account by the team. On the other hand, although the previous committee questioned the development of the landscape evolution theme, this continued to receive considerable attention and growth.

## WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	1
Maîtres de conférences et assimilés	4
Directeurs de recherche et assimilés	2
Chargés de recherche et assimilés	1
Personnels d'appui à la recherche	2
<b>Sous-total personnels permanents en activité</b>	<b>10</b>
Enseignants-chercheurs et chercheurs non permanents et assimilés	1
Personnels d'appui non permanents	0
Post-doctorants	0
Doctorants	7
<b>Sous-total personnels non permanents en activité</b>	<b>8</b>
<b>Total personnels</b>	<b>18</b>

## EVALUATION

### Overall assessment of the team

The team strengths come from a combination of field observations, satellite imagery and modelling over a wide range of space and time scales. Some of the methodologies fall outside the traditional methodologies of tectonics and the mechanics of lithosphere (e.g. aeolian sediments processes) while a limited attention is given to integration with geophysics for characterising continental lithosphere. The scientific production and funding sources are of a very good level. The team members are actively involved in the training of students and communication toward the society about natural hazards.

### Strengths and possibilities linked to the context

The 'Tectonics and mechanics of the lithosphere' team strengths are the results of the excellent combination of competences on field observations, satellite imagery and modelling over a wide range of space and time

scales. Over the last decade, the team has further developed its satellite imagery focus with, and thanks to, a strong link with the Cnes. The development of satellite imagery and more specifically the correlation of optical data led by the team is a definite strength. This new approach combined with expertise in field geology are the roots of the team's strengths and strong foundations to foster collaborations not only with other teams but also national and international teams. This is evidenced by the high quality of scientific production. The support provided by the team to the training of students, especially for field training, which is another strength of the team.

The team's scientific production and funding sources are of a very good level. The members of the team are actively involved in the training of students and young researchers as well as in community outreach and communication toward the society about natural hazards.

## Weaknesses and risks linked to the context

Some of the methodologies employed by the team fall outside the traditional 'solid Earth' methodologies of tectonics and the mechanics of lithosphere deformation, being more closely aligned with 'exogenic' phenomena such as erosion, sediment transport and deposition. At the same time, there is limited attention given to integration with (especially) seismological and other geophysical methodologies for characterising continental lithosphere as a whole and, for example, linking surface processes with intrinsically deeper lithospheric processes that may be important in controlling them.

In the next years, one PR and one DR will retire, which will significantly decrease the number of permanent researchers on the team and will hamper the dynamics of the team in the training of students and young researchers. There seems to be a slight slowdown of incoming funding over the last two years; hopefully, this is just part of the pluri-annual variations in funding and not related to the team cohesion affected by the Covid-19 pandemic. The drawback of the development of data (in this case satellite imagery) driven research, combined with numerical modelling, is always the lack of technical support to address computer-related issues. These very weaknesses are emphasised given the team trajectory on expanding specifically on surface processes monitoring and modelling.

## Analysis of the team's trajectory

The satellite imagery expertise of the team will contribute to study landscape evolution in the context of aeolian processes, and will be an asset for the team regarding this topic. Therefore, the wish of the team to pursue the combination of satellite imagery with landscape evolution modelling seems justified. However, landscape modelling – investigating landscape evolution on a variety of temporal spatial scales is intrinsically linked (as a function of scale) to tectonic processes occurring within the lithosphere, including dynamic uplift and drawdown of the Earth's surface. Any 'broadband' appreciation of landscape evolution will require integration with methodologies defining the structure of the lithosphere as well as mapping of exogenic processes at the surface. A drawback of this development, common to many teams, will be the need of increase in computation and data archiving facilities and support.

## RECOMMENDATIONS TO THE TEAM

With the departure of one associate professor during the last period, the two retirements soon to come and the will to develop further the landscape modelling the team seems at a tipping point. The team must think thoroughly about the profiles of new researchers they would like to hire. Do they want to keep the broad field of expertise the team has built its reputation on, or do they wish to narrow it but with an increase in a more specific expertise?

It seems that greater collaboration with the seismology team, across a spectrum of targets from near-surface to the lithosphere as a whole, could be advantageous, not only to landscape and risk-societal research, but also to other established strengths of the team.

Because of the number of other teams with similar ambitions of expanding numerical modelling and 'data science' as important research elements, consideration should be given to developing a broader remit for such activities within the IPGP as a whole.



**Team 17:** Volcanic systems  
 Name of the supervisor: Mr Fidel Costa

## THEMES OF THE TEAM

The 'Volcanic System' team brings together specialists in geology, geophysics, and geochemistry, developing multidisciplinary and complementary approaches for applications aimed at better understanding the behaviour of active volcanic systems and their impacts. Members of the team have the common objective to monitor, model, constrain and understand the spatio-temporal dynamics of volcanic systems in various geodynamical settings, including subduction, extensional and intraplate domains. All these activities involve a wide spectrum of approaches, from geophysical imagery, modelling of volcanic systems and fluids, geochemistry and petrology.

## CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The first recommendation was to maintain the high scientific production and the quality of the activities. This recommendation has been fully taken into account, since the scientific production has increased to 244 scientific articles (instead of 213), which represent a net increase of 14% (including 6 publications in high-impact journals with strong community recognition). This is remarkable since the team suffered from a net loss of two permanent faculty positions in between the two periods of evaluation.

The two other recommendations, to maintain strong collaborative links and to get involved in the research themes, were fully followed with members of the team involved in the following positions of responsibility: vice director of the IPGP in charge of observatories, director of the observatories of Guadeloupe and Réunion, coordination of all observatories within IPGP Paris, and co-direction of the 'Natural Risks' theme.

## WORKFORCE OF THE TEAM: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	5
Maîtres de conférences et assimilés	10
Directeurs de recherche et assimilés	1
Chargés de recherche et assimilés	3
Personnels d'appui à la recherche	2
<b>Sous-total personnels permanents en activité</b>	<b>21</b>
Enseignants-chercheurs et chercheurs non permanents et assimilés	3
Personnels d'appui non permanents	2
Post-doctorants	2
Doctorants	6
<b>Sous-total personnels non permanents en activité</b>	<b>13</b>
<b>Total personnels</b>	<b>34</b>

## EVALUATION

### Overall assessment of the team

The 'Volcanic Systems' team draws on historical strengths and close links with the Volcano Observatories (OVS), which contribute to its attractiveness and visibility at the national and international levels. Scientific production is at a very good level (244 publications and 10 book chapters, including publications in high-impact factor journals). Half of the members of the team have an HDR and are involved in the training of young researchers. 21 PhDs were defended during the period. The attractiveness of the team is reinforced by its involvement in 45 funded research projects, both national and international. The team is also active in outreach activities that match societal expectations and ensure that its scientific activities reach a broad audience with a transfer of knowledge to public authorities and policy-makers involved in volcanic risk mitigation.

### Strengths and possibilities linked to the context

The 'Volcanic Systems' team has a multidisciplinary activity centred around a clearly identified theme of understanding current volcanic systems and benefits from well-established international recognition in this field. The recognition of this group is reinforced in particular by its involvement in and its strong connections with the various French observatories (Observatories of Réunion, Guadeloupe and Martinique). The team's activity is well balanced between scientific production, training, awareness raising among the general public (TV shows, radio, documentary films, general public conferences) and transfer/advice to the authorities involved in the management of volcanic crises. The recognition of the team and its attractiveness allow it to benefit from various fundings, from national calls (ANR, INSU, MOPGA) or from partnerships with the socio-economic environment (AXA). Scientific production is excellent, with 244 publications in peer-reviewed journals (4.1 article/FTE/year). In addition, over the last period, the team has also been able to invest on attractive new methods for characterising volcanic systems, such as muon tomography. The number of PhD theses defended over the period (21, including 17 directly supervised) is excellent, and shows the team's involvement in training young researchers.

### Weaknesses and risks linked to the context

The great geographical dispersion of the team members, spread across different sites, sometimes located in very different time zones, can create a risk of loss of connection and coordination between the different members, as well as difficulties in cohesion and in the animation of the team.

The C/EC ratio is very low (only 1 permanent CNRS researcher), which could have repercussions on the research dynamics, particularly given the teaching load of ECs and CNAP staffs.

The team has participated in a few European projects (3 large European projects with a team PI or co-PI and 1 European H2020 project, in which the team was partner) and, in particular, there is no ERC project led by the team over the period.

### Analysis of the team's trajectory

For the next contract, the team will continue to be involved with an effective multidisciplinary approach in global challenges concerning the behaviour of active volcanic systems by using a combination of datasets from the IPGP and volcanic observatories, together with innovative analytical and numerical strategies. These challenges range from the more theoretical scientific aspects, related to the general understanding of volcanoes, to the more operative approaches, considering eruption forecasting and risk mitigation also through collaborations with social scientists. Therefore, a complete spectrum of research on volcanoes and their impacts is foreseen for the immediate future of the team. Among interesting elements, the team plans to incorporate the approach of database creation and analysis in a range of aspects, including those related to monitoring data, probabilistic approaches to eruption forecasting and the search for precursors. The use of artificial intelligence and deep learning, together with the improvement and connection between existing large databases such as WovoDat (World Organisation of Volcano Observatories data), Georem (Geological and Environmental Reference Materials) and VolcAshDB (Volcanic Ash database) is very promising in revealing genetic links between processes, volcanic systems and eruptions.

The team also plans to develop further new technologies, such as muography and seismic tomography with the ambition to obtain high-resolution images of volcanic systems and thus help forecast the evolution of volcanoes toward unrest periods or eruptions.

The development of collaborations with other research teams at IPGP and nationally (LMV in Clermont-Ferrand) or internationally (ERI in Japan, HVO-USGS in Hawaii, INGV in Italy and EOS in Singapore) should efficiently contribute to encouraging exchanges and common projects.

## RECOMMENDATIONS TO THE TEAM

The 'Volcanic Systems' team has, in these recent years, confirmed and exploited its relevant potential and, under these premises, it can look forward to a promising set of future activities.

Claimed limitations (teaching duties, thematically widespread research, duties in volcano observatories) may also provide opportunities to strengthen and enrich the work of the team, attracting students on a holistic approach to volcanoes, also supported by monitoring data. Therefore, these potential limitations do not appear as relevant impediments to the activity of the team.

Rather, achieving a unified and effective coordination and cooperation, which involves not only the technical-managing aspects, but also the scientific aspects (research, projects), seems an important challenge to be faced in the near future. As also underlined by the team itself, the various activities, occurring at distinct institutions (IPGP, plus 3 volcano observatories dispersed in up to 11 time zones), may limit the expression of the 'Volcanic Systems' team as a whole, promoting fragmentation and lack of coordination and cooperation.

Therefore, a recommendation to improve the overall cohesion of the team, promoting innovative solutions, is brought to the attention of IPGP.

# CONDUCT OF THE INTERVIEWS

## Dates

**Start:** 9 janvier 2024 à 8 h 30

**End:** 11 janvier 2024 à 19 h

**Interview conducted : on-site**

## INTERVIEW SCHEDULE

### IPGP UMR 7154

tutelles :

UPC-CNRS-IGN-Univ.  
Reunion

Lundi 08 janvier 2024						
Lieux						
Dîner de travail du comité en huis clos avec les représentants du Hcéres M Sosson/H Wozniak		20h00				
Premier jour : Mardi 09 janvier 2024						
		Début	Durée	Fin	Intervenants	Participants
Accueil du comité	Pavillon Curie	8:00	0:30	8:30		Direction
Introduction de la visite par le délégué Hcéres (M Sosson) et le président du comité Michel Campillo	Amphithéâtre	8:30	0:10	8:40	M. Sosson et M. Campillo	Tous
Présentation de l'IPGP du bilan des activités de l'UMR et trajectoire (+questions) Directeur Marc Chaussidon	Amphithéâtre	8:40	1:50	10:30	M Chaussidon + responsables de thèmes (80' présentation+30' questions)	Tous
Pause café	Médiathèque	10:30	0:15	10:45		Tous
Comité 1 avec M Sosson						
Equipe 14 Seismology bilan/trajectoire + questions	Amphithéâtre	10:45	0:40	11:25	Jean Philippe Métaxian (20'+20')	Tous
Equipe 6 Geological Fluid Dynamics bilan/trajectoire + questions	Amphithéâtre	11:25	0:40	12:05	Olivier Devauchelle (20'+20')	Tous
Equipe 5 Geodesy bilan/trajectoire + questions	Amphithéâtre	12:05	0:40	12:45	Olivier Bock (20'+20')	Tous
Pause repas (buffet)	Médiathèque	12:45	1:00	13:45		Tous
Equipe 10 Marine Geosciences bilan/trajectoire + questions	Amphithéâtre	13:45	0:40	14:25	Nathalie Feuillet (20'+20')	Tous
Equipe 13 Planetology and space sciences bilan/trajectoire + questions	Amphithéâtre	14:25	0:40	15:05	Sébastien Rodriguez (20'+20')	Tous
Equipe 16 Tectonics bilan/trajectoire + questions	Amphithéâtre	15:05	0:40	15:45	Yann Klinger (20'+20')	Tous
Pause café	Médiathèque	15:45	0:10	15:55		Tous
Equipe 7 Geomagnetism bilan/trajectoire + questions	Amphithéâtre	15:55	0:30	16:25	Thomas Gastine (15'+15')	Tous
Equipe 12 Physics of natural sites bilan/trajectoire + questions	Amphithéâtre	16:25	0:20	16:45	Frédéric Girault (10'+10')	Tous
Comité 2 avec H Wozniak						
Lieux	Début	Durée	Fin	Intervenants	Participants	
Equipe 15 Stable isotope geochemistry bilan/trajectoire + questions	310	10:45	0:40	11:25	Magali Ader (20'+20')	Tous
Equipe 2 Cosmochemistry Astrophysics Experimental Geophysics bilan/trajectoire + questions	310	11:25	0:40	12:05	Sébastien Charnoz (20'+20')	Tous
Equipe 11 Paleomagnetism bilan/trajectoire + questions	310	12:05	0:40	12:45	Frédéric Fluteau (20'+20')	Tous
Pause repas (buffet)	Médiathèque	12:45	1:00	13:45		
Equipe 17 Volcanics systems bilan/trajectoire + questions	310	13:45	0:40	14:25	Fidel Costa (20'+20')	Tous
Equipe 4 External envelopes geochemistry bilan/trajectoire + questions	310	14:25	0:30	14:55	Julien Bouchez (15'+15')	Tous
Equipe 9 Geomicrobiology bilan/trajectoire + questions	310	14:55	0:30	15:25	Emmanuelle Gérard (15'+15')	Tous
Pause café	Médiathèque	15:25	0:10	15:35		
Equipe 1 Biogeochemistry at the anthropocene bilan/trajectoire + questions	310	15:35	0:30	16:05	Yann Sivry (15'+15')	Tous
Equipe 3 Environmental biogeochemistry bilan/trajectoire + questions	310	16:05	0:30	16:35	Rémi Losno (15'+15')	Tous
Equipe 8 Geomaterials	310	16:35	0:20	16:55	Daniel Neuville (10'+10')	Tous
Pause						
Rencontre huis clos avec les enseignants-chercheurs et les chercheurs de l'unité	Amphithéâtre	17:00	1:00	18:00		Comité total + enseignants-chercheurs et chercheurs (sans la direction et sans les chefs d'équipes)
Dîner de travail du comité en huis clos avec les représentants du Hcéres M Sosson et H Wozniak		19:00				
Deuxième jour : Mercredi 10 janvier 2024						
		Début	Durée	Fin	Intervenants	Participants
Visite des locaux, et des équipements analytiques		8:30	01:30	10:00		Comité + direction+ personnel impliqué (Visite) puis comité uniquement pour réunion
Rencontre huis clos avec les doctorants + post docs	Amphithéâtre	10:00	0:45	10:45		Comité + doctorants + postdocs
Rencontre huis clos avec les personnels d'appui à la	Amphithéâtre	10:55	1:00	11:55		Comité + personnels d'appui à la recherche,
Rencontre huis clos avec les responsables des équipes	Amphithéâtre	11:55	1:00	12:55		Comité + responsables d'équipe anciens,
Repas comité en huis clos (plateaux repas)		13:00	1:00	14:00		Comité
Rencontre Huis clos (Comités UMR-UAR) avec les tutelles	310	14:00	0:45	14:45		Comité + tutelles
Rencontre huis clos avec la direction de l'UMR	310	14:45	1:00	15:45		Comité + Direction
Rencontre huis clos du comité d'experts	Curie	15:45	2:00	17:45		Comité
Conclusion du Représentant Hcéres et Président	Amphithéâtre	17:45	0:05	17:50		Tous

## PARTICULAR POINT TO BE MENTIONED

No particular point to be mentioned

## GENERAL OBSERVATIONS OF THE SUPERVISORS

---

Paris, le 16 juillet 2024

**Marc Chaussidon**  
Institut de physique  
du globe de Paris  
Directeur  
chaussidon@ipgp.fr

Je tiens avant tout à remercier le comité de visite pour son investissement dans l'évaluation de l'IPGP (UMR et UAR). Je souhaite aussi apporter les précisions suivantes quant à certains commentaires faits dans le rapport HCERES sur l'UMR 7154 IPGP.

(1) A plusieurs endroits (pages 6, 8, 9) le rapport revient sur le besoin d'améliorer la communication interne, la prise en compte des difficultés ressenties par les personnels, et l'efficacité ou la rapidité des procédures administratives, notamment celles liées au paiement des commandes engagées et au règlement des frais de mission.

Comme indiqué dans le rapport, depuis l'année 2020 et au-delà de la crise sanitaire exceptionnelle que nous avons alors traversée, l'établissement a connu de profonds changements au sein de ses services centraux. Cela n'a pas été sans incidences ni pour la construction, ni pour l'exécution de nos derniers exercices budgétaires. En effet, suite à un arrêt longue maladie en juillet 2020, l'établissement s'est retrouvé sans directeur des affaires financières. L'adjoint du service étant lui-même parti en mobilité l'année précédente, le service a travaillé en mode dégradé pendant de très longs mois et les retards se sont accumulés. Tant dans le traitement des factures (remboursements missions compris), que dans la perception des recettes.

Aujourd'hui, suite au recrutement d'une nouvelle DAF, le service financier est entièrement réorganisé et les retards en voie d'être tous traités et régularisés. Un point sur ces retards a encore été fait lors d'une dernière réunion de responsables d'équipes.

En revanche, nous ne comprenons pas la remarque du comité d'experts sur les « delays in implementing salary raises ». L'IPGP n'est pas aux compétences élargies et tous ses agents fonctionnaires sont payés par le ministère. Si ce sont des retards pour des agents hébergés à l'IPGP, cette situation incombe aux tutelles de l'unité auxquelles appartiennent ces agents et en aucun cas à l'IPGP.

(2) Le rapport s'inquiète du manque de DUER (Document unique d'évaluation des risques professionnels in french) et de manques en ce qui concerne l'hygiène, la sécurité et la prévention.

Aujourd'hui toutes les questions touchant à l'hygiène, la sécurité et la prévention sont systématiquement discutées lors des séances de notre comité social d'administration (CSA). De plus, un réseau des assistants de prévention a été monté et ce dernier se réunit régulièrement pour échanger sur les évolutions réglementaires, les bonnes pratiques, faire remonter les difficultés etc.

Pour rassurer le comité d'experts, notre DUER, commencé en 2023, sera terminé et disponible dès septembre 2024.

(3) le rapport s'inquiète de l'apparente absence de préparation du déménagement des deux équipes de Lamarck sur le site de Cuvier mi-2026.

Ce déménagement a été mis à plusieurs reprises à l'ordre du jour des réunions « Respeq », ce projet de déménagement a été placé au cœur des discussions lors de notre « dialogue performance » avec le rectorat et nous venons d'obtenir le financement pour lancer un pré-programme auprès d'un cabinet expert à l'automne 2024. Il est aussi abordé dans le cadre du COMP que nous sommes en train de négocier avec le ministère, et nous avons obtenu un financement significatif de la mairie de Paris pour la réalisation des travaux qui devront être faits.

(4) Le comité d'experts souligne à plusieurs reprises, notamment p14, « the need for renewed internal reflection on the psychological dimensions of work and associated suffering ».

Je tiens ici à indiquer que nous avons passé une convention avec la médecine de prévention d'UP Cité en 2021. Depuis la signature de cette convention, la quasi-totalité des agents IPGP et UP Cité ont été reçus par un médecin de prévention. En cas de difficultés, les agents peuvent bénéficier d'une offre médicale et sociale importante : psychologues, psychologues du travail, entretiens avec des assistantes sociales etc.



Nous travaillons également en étroite collaboration avec nos autres tutelles et c'est ainsi que des points réguliers sont faits entre notre service RH et celui du CNRS par exemple. De plus les médecins de prévention d'UP Cité et du CNRS assistent à toutes les séances de notre comité social d'administration. D'autre part, des procédures existent (auprès des RH et de la direction) pour orienter un personnel en difficulté vers les bons interlocuteurs.

(5) Le rapport en p14 suggère « A laboratory council would be an internal structure enabling direct contact and discussion between representatives of all groups and management, more easily than in councils including external members. »

Comme expliqué dans notre rapport, ce conseil, nommé Respeq existe déjà, se réunit mensuellement et regroupe les responsables d'équipes, d'observatoires, des services administratifs et la direction, et ne comporte aucun membre extérieur. Les conseils qui comportent des membres extérieurs, des membres de l'IPGP élus et nommés, sont les 4 conseils statutaires : conseil d'administration, conseil scientifique, conseil pédagogique, comité social d'administration.

(6) Le rapport identifie comme une faiblesse une réussite qui serait trop faible aux appels ERC eu égard à l'expertise et la reconnaissance des équipes de l'IPGP (p9 et à d'autres endroits).

Bien qu'on puisse toujours augmenter notre taux de réussite à l'ERC, et que des actions sont d'ailleurs entreprises en interne pour aider l'émergence de ces demandes, la faiblesse de notre taux de réussite me semble toute relative avec 7 ERC en cours et 2 autres obtenues depuis le comité de visite.

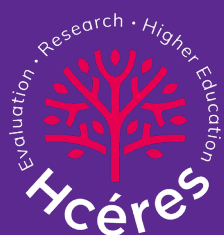
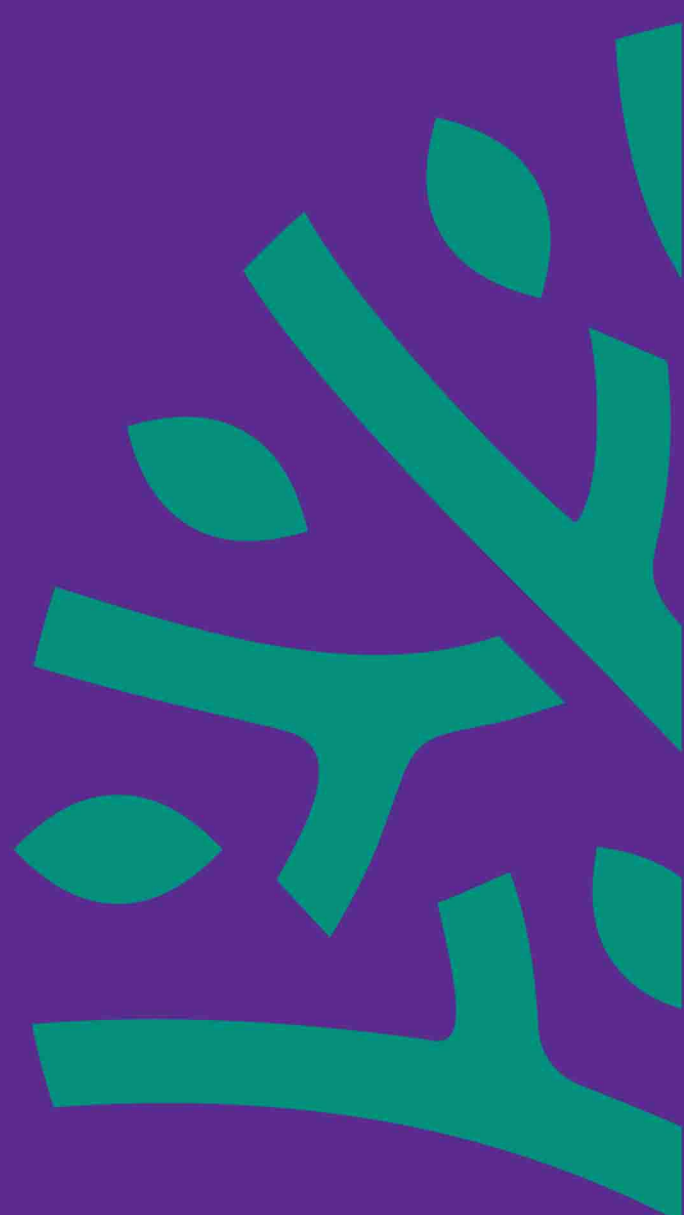
Marc CHAUSSIDON  
Directeur de l'institut de physique du globe de Paris





The Hcéres' evaluation reports are available online:  
[www.hceres.fr](http://www.hceres.fr)

**Evaluation of Universities and Schools**  
**Evaluation of research units**  
**Evaluation of the academic formations**  
**Evaluation of the national research organisms**  
**Evaluation and International accreditation**



2 rue Albert Einstein  
75013 Paris, France  
T. 33 (0)1 55 55 60 10

[hceres.com](http://hceres.com)

[@Hceres\\_](https://twitter.com/Hceres_)

[Hcéres](https://www.youtube.com/Hceres)