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| **Research Group** |  |
| **Date due** | **w/c 11/1/2021** |

Please complete this form to tell us about your future plans for your Research Group. You are asked to complete a 1 page strategic three-year plan for your Research Group and also to detail your plans for infrastructure and technical support, highlighting areas where investment is required, what academic hires would help to deliver your strategy, and outline your expected research income generation over the next year.

**Strategic Research Plan for next 3 years 2021-2023**

*Please provide a one page strategic plan for your area outlining the following:*

* ***Likely long-term directions which may require addressing through academic hires/infrastructure***
* *main goals and targets to be achieved.*
* *current activities that will grow or reduce.*
* *future areas for expansion and development.*
* *interactions with other RGs, institutes, departments, faculties*
* *brief reflection on impacts to UN Sustainability goals and CO2 footprint*

The Geoscience group undertakes research to understand the fundamental physical and chemical processes that govern interaction between the deep Earth, surface and atmosphere. In order to unravel the complexities of these interactions we exploit the geological record of past events and use direct and remote sensing observations of modern processes and a range of modelling approaches. Our key research strengths are in the areas of Rock Physics, Petrology and Volcanology and are underpinned by a strong infrastructure and equipment base. Our research group has a strong seminar programme, and a research focus group has been initiated under the direction of David Neave to disseminate research experience and explore potential new research directions and opportunities across the different research themes.

**Rock Physics:** The team has a good record of UKRI and industry funding and has strong links with the Basins Group and with MACE. There is a record of strong industrial links, particularly for shale gas, but interests also extend into HPHT experiments with relevance to petrology. Success is founded on world-class experimental facilities, strengthened by the recent acquisition of a TZM pressure vessel apparatus and funding to support its development. There is high potential for growth with new funding opportunities likely to increase in CCS, geothermal energy (e.g. UK Geoenergy Observatories) and related areas of geoengineering. This will help to diversify funding streams to EPSRC, BGS and new industrial partners. The forthcoming appointment of Chris Jackson as chair in Chair in Sustainable Geoscience will help boost this effort. An ability to attract fellowship is evidenced by a recent Leverhulme Fellow. The recent appointment of Simon Hunt as Presidential Fellow in Materials, provides the potential for developing research in mineral physics, and an important bridge between Rock Physics and Petrology. A research focus group has been initiated under the direction of Neave to disseminate research experience and explore potential new research directions and opportunities.

**Petrology:** Igneous petrology and geochemistry is a vigorous area with strong links to the Planetary Science group. The focus over the short-medium term will be to continue to develop funding proposals and it is critical that staff involved are supported in this endeavour. There is good potential for growth and success in petrology thanks to world-class experimental and analytical facilities, and has been strengthened by the recent addition of two Presidential Fellows in this area, both of whom cross-over with volcanology.

**Mineral dust ingestion in aircraft engines**: The DUST Research group (DEES-MACE collaboration) focuses on the ingestion of airborne mineral particulates into aircraft engines, their harmful effect on engine performance, and the environmental impact of aviation. Research priorities are: (1) the aerosolisation, transport and distribution of atmospheric dust; (2) the chemical and mechanical evolution of mineral dust as it passes through a gas turbine engine; and (3) aircraft flight performance and predictive maintenance of aircraft engines. The group has been successful in attracting recent industry funding from the EPSRC Impact Accelerator Award, Knowledge Transfer Partnership, UK Defence Science and Technology Laboratories, and Rolls-Royce UK, and UKRI funding from EPSRC. Immediate priorities are to commission an EPSRC funded jet mill and develop a powder production and characterisation laboratory to produce bespoke mineral powders; and to continue developing new experimental rigs for investigating high energy/high temperature particle impacts. To support this there is a one-year postdoctoral fellowship starting mid-2021.

**Volcanology**; This is a well-established group that has attracted significant levels of funding. Major research efforts will continue throughout the next 2 years on the NERC funded DisEqm project involving modelling and 4D tomography using cutting edge facilities. A priority area for development will be volcanic SO2/ash studies utilising satellite data and trajectory modelling with application to global volcanism. This will enable the team to leverage funding related to the European Sentinel satellites that generate huge quantities of raw data that rely on complex modelling to create reliable observations. The team has a strong record of funding and publications and attracting ECR fellows. The ECRs actively applying for research grants and senior fellowship applications (Royal Society, UKRI FLF) and are being mentored and supported at Group and Department level.

A potential new research direction we have identified is landscape evolution and Earth observation science. Our current expertise does not incorporate the evolution of the landscapes, landforms and coasts through natural processes. This limits our ability to combine anthropogenic and climate change on landform evolution (both marine and terrestrial), and our versatility to exploit emerging cross-disciplinary approaches including: the coevolution of landscapes, climate, tectonic systems, life, and the sedimentary record; land-water-soil change and impacts; earth surface processes occurring at urban-agricultural-ecology interfaces; and natural hazards over any spatial and temporal scales. We see an academic appointment allied to an existing research strength as being a means to progress in this area. A business case should be developed that encapsulates both international growth in this key area and the potential for broadening research funding e.g. UKRI Strategic Priorities Fund, Landscape Decisions programme, and benefits from cross-Faculty initiatives including MERI, the Centre for Crisis Studies and Mitigation and the Global Development Institute.

*Please provide evidence to support the aspirations and how new developments will be realised. It is important that you consider the staff, technical support and infrastructure resources that will be necessary to deliver any increase in activity and to justify these in your plan. Please also indicate any plans for increasing your number of research fellows and how you see PhD studentship increase being generated and grown. Please indicate where you have staff or Early Career Researchers that would benefit from additional support in preparing applications for funding from either your Research Support Manager or an academic mentor.*

* ***Whats gone well/less well?***

The effects of COVID-19 has curtailed experiments, analyses and all fieldwork and is having an overall cumulative negative impact on research progress. The lack of a DTP is affecting new appointments who need to build a team, but the good news here is that Faculty have funded a studentship for Presidential fellows.

**Outline how you will use university/department infrastructure and technical support in the next year, highlighting where any investment is required**

Geoscience research is centred on experimental petrology, DUST and the rock mechanics laboratories, and makes use of analytical facilities in MAGU, WRC and Isotopes. Faculty have allocated funds (£170k) to refurbish the basement area for the TZM pressure vessel with work planned to start in 2021. Refurbishment of the DUST laboratories to commission the recently acquired EPSRC funded jet mill and develop a powder production and characterisation laboratory will require support from Estates during the first quarter of 2021. The WRC RADER refurbishment will extend a range of instrument capability and we will work closely with colleagues in WRC to utilise the new facilities where possible. There is need for a new SEM instrument which is critical for several research groups and will require a co-ordinated approach to gain investment. We will continue to work closely with Materials and other schools in FSE to maximise return on the new advanced analytical suite in the in PSI/Royce. Several academic staff within Geosciences work closely with national facilities and successfully apply for access costs to the Diamond Light Source (Volcanology for 4D tomography) the Archer Supercomputing Service (Volcanology for numerical modelling) and the Edinburgh Ion Microprobe Facility (Petrology – isotopic and trace elements analyses).

**Outline any upcoming staffing changes or gaps and opportunities to achieve strategic goals or maintain existing strengths**

Our technical staff are overstretched. There is a critical need for an additional post for EMPA , a replacement thin section technical post and a further post in MAGU. A moderate level of technical support is required for overseeing the Jet Mill and associated facilities in the Powder Characterisation and Production Lab (not a time consuming role but important). Technical support is probably the most critical issue and it will be difficult for the group to progress at the current level.

A new staff position is highlighted in the above research plan: Landscape modelling/Earth observation. A case for a can be developed based on evidence for growing research in the area and fit within Geosciences and across DEES.

**Research Income Generation for the next year**

Please detail your future plans for research income generation over the next 12 months (identifying the lead academic where possible). Please detail any planned applications in the table provided on the last page.

**UKRI and other UK funders (eg Royal Society, Leverhulme)**

*Please identify developing research programmes, highlight topics, large grant opportunities, UK/US collaborations and fellowships in your research area and your plans for targeting these programmes? When will they occur and who in the group will lead and who will contribute to the activity? Are there any obstacles to delivery?*

The main funders will continue to NERC. There is potential for growth in STFC (planetary volcanism) and further engagement with EPSRC (DUST project) The flat-level of funding for Discovery science means we will need to direct more effort to shaping Strategic Research and Partnership Opportunities. We will encourage progress by applying to be team members/PIs of major UK Science initiatives particularly in areas specialist data acquisition or exploitation relevant to our expertise. Potential opportunities exist within geoenergy, CCS, ocean and continental drilling, satellite observation, BGS, BAS etc. Current efforts are nascent, but more is planned. Barriers to progress mainly relate to the time required to help develop proposals, particularly in larger collaborative efforts where any potential rewards are not realised for several years.

**Other funding sources**

*Please identify developing research programmes funded from non-UK sources*

Our main EU activity is through volcanology and European Research Council grants. If UK access to Horizon Europe is agreed (or a UK derivative), then ERC grants are a priority for us however planning is delayed until the situation is understood. Volcanology has involvement in EuroVolc, an H2020 infrastructure project, which will be used to leverage Marie Curie applications, which is strengthened by the strong training we can provide as a university. Again, the main obstacle is the UK’s relationship with the participation in the Horizon Europe programme, which has made EU mainland colleagues wary of collaboration. The Dust group have an EPSRC PhD iCASE student starting Jan 2021 and are applying for CSC funding for a PhD studentship to start Sept 2021. There is good potential for growth in our relationship with Rolls-Royce and we are strengthening this potential by developing collaborations with Aarhus Group (with wind tunnel experiments funded through Europlanet 2024 research infrastructure), Virginia Tech, Oxford, and Bristol.

**Business engagement**

*Please describe the development of current industrial relationships or consortia and your plans for them. Are there any new industrial partnerships or areas of engagement that you see developing? Who in the group will lead these and what is the projected size and timescale? What plans do you have for applications for Industry Collaboration Funding (IAAs, KTPs) Innovate UK competitions and the Industrial Strategy Challenge Fund competitions? Would you like to enlist the help of the Business Engagement Office to support any of the planned activities of your Group?*

The DUST research group collaboration with Rolls-Royce offers a high potential for a follow on postdoc in 2021 and funding of further PhD students. This group has submitted a white paper to the US Army Research Laboratory for funding through their Basic and Applied Scientific Research Fund, which is being coordinated through the Business Engagement Office. If the engagement across the University is successful then this could lead to a multi-university research initiatives (MURI), which is a large grant of $4-5 million in which one UK university is matched with one US university to address a range of research challenges. The other main area for industrial relationships is through Rock Physics research in Shale Gas.

*Please list any planned applications over the next 12 months:*

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| **PI and team** | **Sponsor/Call**  | **Research Area/Proposal Title** | **Date**  | **Value** | **Chance of success (%)** | **Comments** |
| McCormick Kilbride | UKRI FLF outline | The deep origins of volcanic gases | Feb 2021 | £1 M | 25 |  |
| O’Driscoll  | NERC standard | Volatile budget of sulfide melt in basaltic magma systems | Feb 2021 | £0.7 M | 20 | With Oxford |
| Burton | NERC standard | Gas and Tremor | July 2021 | £0.4 M | 20 | With Liverpool |
| Hartley (as Co-I) | NERC standard | Magmatic volatiles in the South Sandwich Islands | ?July 2021 | ? | ? | Led by UCL |
| Polacci | UKRI FLF | Magma ascent and eruption dynamics by 4D tomography and numerical modelling | Pending | £1.5M |  | Partners in US, Italy and France |
| Jones, Pawley, Covey-Crump, Bojdo (MACE) | CSC | The influence of dust deposit heterogeneity on gas turbine engine damage | Jan 2021 | ? |  | 4 year PhD plus fees plus Rolls-Royce research support (£8k) |
| Jones, Pawley, Covey-Crump, Bojdo (MACE) Gallagher, Lloyd | EPSRC | Composition and distribution of mineral dust in the atmosphere | Dec 2021 |  |  | Incorporating FAAM aircraft mission with NCAS |
| Jones, Pawley, Covey-Crump, Bojdo (MACE) | Rolls-Royce UK | Creation of a global mineral dust database | July 2021 |  |  | Post doc (likely 1 year although they hint at more) |
| Jones, Pawley, Covey-Crump, Bojdo (MACE) | Europlanet 2024 | Controls on the resuspension of dusts of different mineral composition in air flows: implications for aircraft engine damage mitigation | Jan 2021 | - |  | Access to research facilities with Aarhus (Denmark) |
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