Plan Overview

A Data Management Plan created using DMPonline

Title: Spodumene pegmatite haloes: characterization, exploration vectoring and ore potential

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Template: Health Research Board DMP Template

Project abstract:

The growing demand for lithium is driven by the need for a clean energy and transportation transition (Bibienne et al., 2019). To date, the majority of lithium is extracted from salars, their occurrence however is in the main part restricted to South America and subordinately China. Hard-rock lithium sources such as Li-Cs-Ta (LCT) pegmatites (e.g. Selway et al. 2005) or rare metal granites (RMG) have a wide distribution globally and in Europe specifically (e.g. Gourcerol et al., 2019). Spodumene is a Li-Al pyroxene ($LiAlSi_2O_6$) and spodumene pegmatites are the main hard-rock source for lithium. Often not or poorly exposed, the first step in successful Li exploitation is the establishment of quick and comparably cheap exploration tools. This project aims to target the metasomatic haloes surrounding the pegmatites and employ the geochemical halo signature in certain minerals as a tool to vector towards spodumene pegmatites. The preliminary research hypothesis states that the parental liquids of the spodumene expel a- or multiple pulses of a hydrothermal fluid at the transition between magmatic and hydrothermal conditions. The process by which this fluid separates from the late-stage magmatic liquid may be liquid immiscibility (Kaeter et al., 2018). The expelled fluid forms chemical haloes around the pegmatite intrusion, the intensity of this halo signature decreases with increasing distance from the pegmatite. The main study area is located in Ireland in the southern part of Leinster, where both barren as well as mineralized pegmatites intruded the East Carlow Deformation Zone along the margins of the ~400 Ma (Fritschle et al., 2018) Leinster granite. The objectives of the research projects are both scientific as well as economic in nature. Scientifically, the process of halo formation is aimed to be constrained from the chemistry of certain mineral phases and subsequently connected to the processes of pegmatite crystallization. The question whether halo formation should be seen as single-or multi scale process is central. The second part of the project is economically in nature and aims to establish effective tools for future exploration of hard-rock lithium sources. A hand-held Laser Induced Breakdown Spectrometry (LIBS) method is to be developed, which aims to make detection of the halo signature on drill cores and outcrops further away from the pegmatite possible. For the same reason geochemical analysis of typical halo minerals in stream sediments is planned in order to detect mineralized pegmatites upstream.

References cited:

1. Bibienne, T., Magnan, J.-F., Rupp, A. & Laroche, N. From Mine to Mind and Mobiles: Society’s Increasing Dependence on Lithium. Elements 16, 265–270 (2020).

2. Fritschle, T., Daly, J. S., Whitehouse, M. J., McConnell, B. & Buhre, S. Multiple intrusive phases in the Leinster Batholith, Ireland: geochronology, isotope geochemistry and constraints on the deformation history. JGS 175, 229–246 (2018).

3. Gourcerol, B., Gloaguen, E., Melleton, J., Tuduri, J. & Galiegue, X. Re-assessing the European lithium resource potential – A review of hard-rock resources and metallogeny. Ore Geology Reviews 109, 494–519 (2019). 4. Kaeter, D., Barros, R., Menuge, J. F. & Chew, D. M. The magmatic–hydrothermal transition in rare-element pegmatites from southeast Ireland: LA-ICP-MS chemical mapping of muscovite and columbite–tantalite. Geochimica et Cosmochimica Acta 240, 98–130 (2018).

5. Selway, J. B. A Review of Rare-Element (Li-Cs-Ta) Pegmatite Exploration Techniques for the Superior Province, Canada, and Large Worldwide Tantalum Deposits. Exploration and Mining Geology 14, 1–30 (2005).

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Spodumene pegmatite haloes: characterization, exploration vectoring and ore potential

Data description and collection or re-use of existing data

How will new data be collected or produced and/or how will existing data be re-used?

New data

For each type of data / method of data acquisition, explain the steps taken before data collection itself: field work, cutting thin sections, etc. Include petrography as data collection. Then briefly describe the analytical method in each case.

Re-use of existing data

This would include the GREENPEG data set

What data (for example the kind, formats, and volumes), will be collected or produced?

For each of the types of data in the previous section, state:

The nature of the data (e.g., numerical, descriptive), the file format (e.g. .xls, .pdf) and the total size of in megabytes or similar units. You can also include here the GREENPEG data.

The example seems to combine the answers to this section and the previous one, which is unhelpful, but putting the information in tables is a good idea - you can generate tables with the right-hand icon above.

Documentation and data quality

What metadata and documentation (for example the methodology of data collection and way of organising data) will accompany data?

There seems to be no widely accepted metadata standard for geochemical data, or for petrographic data. I think you can answer this by creating a version of the range of metadata listed in Chamberlain et al. (2021). For geographical metadata on drill core samples you should also include latitude, longitude, azimuth (compass direction) and inclination from horizontal of the hole, and the position in metres of the sample within the drill core. The same metadata will apply to most of your datasets, so a table method by method would be unnecessarily repetitive. For rocks, indicate the lithology and unit to which it belongs. For minerals, give the mineral name, and the rock type it occurs in. Put the lab-related things in the next section of the plan.

It would be a good idea to add a second table dealing with curation of physical samples. This should include sample number, type of material (rock specimen, mineral specimen, thin section, etc.), lithology of rock or name of mineral, approximate size or quantity of rock or mineral specimen, for thin section whether covered, uncovered, polished, approximate thickness and what it has been used for (optical, SEM, EPMA, LA-ICP-MS, etc.). The storage location after your project ends should also be included as an item, even though you won't know where that is.

What data quality control measures will be used?

Make a table that shows for each type of geochemical data the types of quality control measures used, using Chamberlain et al. (2021). This would also be the logical place to include what they list under laboratory information. Don't try at this stage to state what the various standards etc. are for each method. This is a plan, not the actual archive.

Storage and backup during the research process

How will data and metadata be stored and backed up during the research process?

State what you are doing at the moment for storage and backup. Note the UCD guidance on Google Drive for file storage. Then we can review it and see if any change to practice is needed.

How will data security and protection of sensitive data be taken care of during the research?

Talk about password protection on your laptop, and of specific files if they are confidential to Blackstairs or anyone else. However, apart from company files, there is no serious worry here about data confidentiality - we don't have to protect personal details, or anything related to national security! See also the text below in the example for more things to include.

Legal and ethical requirements, codes of conduct

If personal data are processed, how will compliance with legislation on personal data and on security be ensured?

No personal data will be used in the project.

How will other legal issues, such as intellectual property rights and ownership, be managed? What legislation is applicable?

It is anticipated that intellectual property generated by the project will be made available as open access scholarly publications. Where it would be desirable to include pre-existing IP of mineral exploration companies, their permission will be sought before including it in scholarly publications.

What ethical issues and codes of conduct are there, and how will they be taken into account?

There are no ethical issues relating to people or animals.

Both UCD researchers named on this project have passed the Epigeum Research Integrity online course organised through UCD.

Ethical considerations apply to the use of proprietary data originating in exploration companies. Such data will remain confidential to the two researchers unless and until the owner of the data gives permission for wider dissemination, which may include presentation at conferences, inclusion in scholarly publications, or possibly even inclusion in final archiving of project data at the end of the project.

Data sharing and long-term preservation

How and when will data be shared? Are there possible restrictions to data sharing or embargo reasons?

There are no data that must be destroyed for any reason.

All data generated by the project will be made publically available. Data used by the project but originating elsewhere may be made publically available if the owners of the data agree and it is useful to do so, i.e. the data are not publically available elsewhere. Much of the data will be published in open access peer-reviewed scientific papers, including supplementary data. Whilst some should be published before the end of the project, the time required for write up, review and publication means that some will be published after the end of the project.

How will data for preservation be selected, and where data will be preserved long-term (for example a data repository or archive)?

When all data worthy of publication has been published, all project data, whether in peer-reviewed publications or not, will be uploaded to Zenodo (https://zenodo.org), a multi-disciplinary open repository maintained by CERN. A digital object identifier (DOI) is automatically assigned to all Zenodo files and Zenodo provides detailed guidance on file naming and structuring, and on metadata.

What methods or software tools are needed to access and use data?

This seems to repeat an earlier section, but put it in here too and again refer to the UCD guidance to the right of this panel.

In here you should also think about chemical mapping data. I suggest you first talk to Maurice Brodbeck to find out what he is doing to archive your data. If there is a pathway in what he is doing to allow your raw data from chemical mapping to be made public, you can refer to that. More likely, he is just archiving it for our own use and we then have to think about it some more!

How will the application of a unique and persistent identifier (such as a Digital Object

Identifier (DOI)) to each data set be ensured?

A DOI will automatically be attached to each data set when it is archived with Zenodo.

Data management responsibilities and resources

Who (for example role, position, and institution) will be responsible for data management (i.e. the data steward)?

During the lifetime of the project, Elena Geiger is responsible for data capture, metadata production, data quality, storage and backup, data archiving, and data sharing, under the guidance of Julian Menuge. When the project ends, Julian Menuge will be responsible for all data management and stewardship roles.

The DMP will be constructed and maintained by Elena Geiger, under the guidance of Julian Menuge, for the duration of the project. Any updating of the DMP required after the end of the project will be carried out by Julian Menuge. It is anticipated that Julian Menuge will retire from UCD in September 2028, two years after the planned end of the project. It is likely that all project data will be archived by Zenodo well before September 2028.

What resources (for example financial and time) will be dedicated to data management and ensuring that data will be FAIR (Findable, Accessible, Interoperable, Re-usable)?

The time required for data management will be reckoned as part of the PhD research time of Elena Geiger and the UCD employment of Julian Menuge. The iCFAG grant supporting the project includes money for some open access peer-reviewed publication, and additional open access charges for publication are expected to be met by the agreements between UCD and major publishers. There are no other foreseen financial requirements; indefinite archiving on the Zenodo site is free of charge.