

Answering a question you did not ask me- where do NYF pegmatites come from?

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Cars, cellphones, batteries and Tv's (just to mention a few) form part of our everyday lives yet have you ever wondered what runs these gadgets and where, whatever that is comes from? With the change of focus from fossil fuels to greener alternatives for energy production (out with the old, in with the new), what exactly will be used to replace non-renewable energy? Well, the answer is rare-earth elements. As the word suggests, these are rare elements simply meaning they are scarce on the Earth's surface. These rare-earth elements are hosted in pegmatites, amongst other rocks. Pegmatites belong to a group of igneous rocks that are characterised by very very large crystals. Pegmatites that have 'special' minerals that are made up of these rare-earth elements are separated into two groups based on which elements are present. So, there is "LCT" pegmatites which stands for lithium, caesium, tantalum bearing pegmatite and then there is "NYF" pegmatites which stands for niobium, yttrium, fluorine bearing pegmatite. Since LCT pegmatites are usually spoken about often, here we will talk about the more neglected or the 'black sheep' of pegmatites if you may, called NYF pegmatites.

The Orange River pegmatite belt (ORPB) is a 450 km long pegmatite belt that stretches from the Steinkopf area to Kenhardt in the Northern Cape Province. The ORPB is made up of more than 30 000 pegmatites that are both LCT and NYF in character. These pegmatites were brought onto the Earth's surface between 1040-960 million years ago. NYF pegmatites are dominant in the central part of the ORPB and occur in a tectonic domain called the Kakamas Domain.

Ok, so where do they come from?

Well, I wish I could give a straight-forward answer to that but what is research without some unanswered questions? So, NYF pegmatites in general are known to have formed in a variety of ways, however NYF pegmatites from the ORPB are not as easy to point out their origin because they are much younger than the other rocks that could have made them and they are too far apart to assume a relationship with these rocks. So the PhD study began when we wanted to find out where these NYF pegmatites come from (so who is their mother). To answer this question, we measured the elemental isotopes (atoms of the same element with different masses and which occur in different proportions in a mineral over time) of Samarium and Neodymium in monazite (rare-element bearing mineral) and titanite (titanium bearing mineral) from the NYF pegmatites. We then analysed these minerals using a laser installed in a fancy machine called the Inductively Coupled Plasma Mass Spectrometry (ICP-MS). Afterwards, we used the ratios of these isotopes to tell us how concentrated or depleted these elements are in the earth's crust and we expressed this using the epsilon notation (ϵNd) which is just a term used to express the degree of neodymium enrichment in rocks. This notation will tell us which rocks could be the possible parent to the NYF pegmatites. A bit like getting a DNA test, but for rocks in this case. The data of the possible parent rocks that are found around the pegmatites were collected from other people who wrote about these rocks (see the importance of research?). By using this technique, we found that NYF pegmatites in the Kakamas domain could come from partially melting (a process by which a solid rock is heated and melts a little bit to form some liquid) of the other rocks that are found in this domain because of their similar values.

Gneiss, tell me more!

Besides pegmatites being incredibly fascinating rocks especially because of how big crystals get to be in these rocks, they are also economically important rocks, for example, pegmatites in the ORPB were

mined since the beginning of the 1900's, infact, some of these pegmatites are currently being re-evaluated for their mineralization and you do know what this means right? More exploration means more questions and answers will be needed and not to brag, but now is a great time to be a geologist!