In situ Rb-Sr geochronology of exotic pegmatite minerals, direct dating of polylithionite-trilithionite, pollucite and rhodizite

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Geochronology of pegmatites have historically been plagued by numerous disadvantages, many of the traditional phases targeted for U-Pb or Pb-Pb (such as zircon or columbite group minerals) are usually unsuitable for geochronology due to the volatile-rich environment found in granitic pegmatites. These phases could have inherited ages, usually exhibit complex zonation, and are as a rule, subject to metamictization which in turn leads to that they are frequently altered with secondary U or Pb minerals. All these factors contribute to difficulties retrieving reliable geochronological information of the pegmatite intrusion.

However the *in situ* Rb-Sr method is a quick, easy, inexpensive and powerful method that can be applied to a large variety of rock-types (Zack & Hogmalm 2016; Hogmalm et al., 2017). This now established approach poses significant advantages over conventional methods, in that inclusions and alterations can be avoided. The high spatial resolution can not only resolve cooling ages, or reheating events but also help us understand recrystallization during deformation. Applied to minerals with a high Rb/Sr ratio such as many pegmatite mineral, there is no need for a coeval Sr-bearing phase (Rösel & Zack 2022). This allows for single spot ages to be calculated, which highlights this method as an attractive tool for pegmatite geochronology.

These new advancements have opened up a whole new range of exotic minerals commonly occuring in evolved grantic pegmatites as a target for in-situ Rb-Sr dating. The Li-bearing micas polylihtionite $K(Li_2Al)(Si_4O_{10})(F,OH)_2$ and trilithionite $K(Li_{1.5}Al_{1.5})(AlSi_3O_{10})(F,OH)_2$ (usually in older litterature denoted as “lepidolite”) are usually indicators for such evolved pegmatites (LCT, lithium-cesium-tantalum) and more fractionated pegmatites can host the uncommon zeolite pollucite $(Cs,Na)_2(Al_2Si_4O_{12}) \cdot 2H_2O$. Premilinary investigations show that these mineral readily incorporate Rb and are almost devoid of intial Sr, making these minerals ideal candidates for this method. This new methodology was applied to pollucite and Li-bearing micas from a vast range of evolved pegmatites from all over the world, ranging in age from Elba (~7 Ma) to Tanco (~2630 Ma). Additionally the rare mineral rhodizte $(K,Cs)Al_4Be_4(B,Be)_{12}O_{28}$ from Ambositra, Madagascar was also analyzed and gave favourable results.

This approach could be a valuable tool in mineral exploration, in particular for the critical elements such as Li, Cs and Ta. Additionally retrieving age information from these minerals advances our understanding of the post-magmatic processes affecting pegmatites.

References

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