

Refining the record of terrestrial Pb isotope evolution using *in-situ* K-feldspar analyses

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References:

- [1]Patterson(1956), *GCA*.
- [2]Armstrong(1968), *Reviews of Geophysics*.
- [3]J.D. Kramers and Tolstikhin(1997), *Chemical Geology*.
- [4]J.S. Stacey and J.D. Kramers(1975), *EPSL*.
- [5]Maltese and Mezger(2020), *GCA*.
- [6]Miller et. al.,(1994), *Nature*.

The U-Pb system is one of the most versatile, yet complex geochemical tools used in geochronology [e.g. 1] and understanding the differentiation history of the Earth [e.g. 2]. Different reservoirs on Earth can develop distinct U/Pb ratios, given Pb is more fluid mobile and less incompatible than U [e.g. 3], yet planetary Pb isotopic evolution ostensibly appears well approximated by a single reservoir with little changing U/Pb. The classic reference model of terrestrial Pb isotope evolution fitted a wide range of conformable crustal sulphides and K-feldspars with a two stage $^{238}\text{U}/^{204}\text{Pb}$ (μ) from 4.57Ga to present, with only a subtle change from $\mu = 7.2$ to 9.7 at 3.7Ga [e.g. 4]. More recently an independent estimate of the Bulk Silicate Earth argues for a constant μ of 8.6 [5]. Such simple evolution curves leave little room for the preferential enrichment of Pb in the continental crust predicted by modern processes of arc magmatism [e.g. 6].

To further explore this intriguing problem we have undertaken a new set of Pb isotopic measurements through accessible Earth history, using *in-situ* analyses of K-feldspars from samples with well-preserved igneous textures screened for metamorphic alteration using SEM-CL. We have selected chronologically diverse K-feldspar bearing granitic samples from the Grenville province, Halls Creek orogen, Lachlan fold belt and the Pilbara, Kaapvaal, North China, Sao Francisco and Rae cratons. The samples were analysed *in-situ* using the novel CC-MC-ICPMS/MS with a quadrupole mass filter ('Proteus'), where NH_3 was used as a reaction gas to remove any isobaric interferences on ^{204}Pb from ^{204}Hg . The spatial resolution of this approach allows us to avoid or reject radiogenic inclusions or cracks. We use these Pb isotope data in combination with zircon U-Pb ages and Hf model ages of crustal extraction from the same samples to attempt to constrain a mantle Pb isotopic evolution curve. Strikingly, our initial results reproduce an evolution curve very close to those in the literature despite using a notably different dataset.