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Lithium and Molybdenum isotopes trace the dehydrated oceanic crust in generating arc magmatism: a study of the Early Palaeozoic Fushui

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Subduction systems contribute to the chemical evolution of the planet by recycling elements, minerals and even rocks from the upper crust back into the mantle. Arc volcanic rocks with a characteristic range of trace elements and isotopic compositions, provide constraints on the influx of crustal material, either in the regime of the metasomatized mantle wedge model or the mélange diapir model. The contribution of mélange where bulk mixing of subducted material forms a mélange transferred to the subarc mantle source through a diapiric rise can hardly be investigated by conventional geochemical proxies. The heterogeneous isotopic composition of Lithium and Molybdenum in arc igneous rocks provides a complementary approach to constrain the relative importance of different slab component and the pattern of crust-mantle interaction. The Fushui mafic complex in the Qinling Orogenic belt is considered an Andean-type arc formed during the subduction of the Proto-Tethyan Oceanic slab. These mafic intrussives exhibit typical arc-type trace element features and enriched radiogenic isotope compositions. Previous studies are controversial between a mantle metasomatized by aqueous fluid and anoxic sediments melt, or a sub-arc source incorporated by AOC fluid and serpentinite through mélange diapir processes.

Here, we report Lithium and Molybdenum isotope compositions of the Fushui igneous rock with composition span from gabbroic to dioritic, to trace their source nature and to constrain metasomatic components transferred during the early Paleozoic subduction event. The Fushui rocks exhibit light Li isotope composition (-7.20 to 1.49‰) providing evidence for the contribution of dehydrated slab serpentinites. The variable Mo isotope values (−0.11 to 0.44‰) further suggest the contribution of aqueous fluid and sediment melt in the mantle source. Combined with previously published data the source of the Fushui complex incorporates a bulk mix of dehydrated slab serpentinite, sediments and AOC fluid in the source of Fushui arc. Providing a new perspective to detect the generation of arc magmas by mélange processes and the recycling of dehydrated oceanic lithosphere in ancient subduction systems.