Low-δ^{56}Fe ferrobasalt reveals the iron cycle of the Awulale arc belt, western Tianshan (China)

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The subduction factory is the key organization to control the material cycle between the Earth interior and surface, and has great contribution to compositional variations of arc magmas and metallization. Arc magmas are usually characterized by high H_2O contents and high oxygen fugacity [1], facilitating magnetite removal from the early-stage magmas and inhibiting later iron enrichment [2]. Hence, it is theoretically difficult to develop iron mineralization via arc magmatism. Actually, several large-scale iron deposits were explored in the Awulale arc belt, the western Tianshan (China) and closely associated with the ferrobasaltic rocks in time and space. These ferrobasaltic rocks were thought to be the parent magmatic rocks for their iron mineralization. Revealing the petrogenesis of these ferrobasaltic rocks could be of great help to decipher the iron enrichment mechanism and iron origin of these deposits.

A Late Carboniferous (314 Ma) high-Mn tholeiitic ferrobasalt was identified in the Chagangnuoer iron deposit of the Awulale arc belt. The ferrobasalt displays abnormally light δ^{56}Fe compositions (-0.401±0.032‰−-0.165±0.059‰), far lighter than basalts reported elsewhere. We proposed that the low-δ^{56}Fe signature was originated from a modified sub-arc mantle metasomatized by Fe-carbonate melts whereby the Fe-carbonate sediments on the subducted slab might had melted due to the thermal effect of upwelling asthenosphere mantle, and then metasomatized overlying mantle wedge to generate a high-Fe-Mn low-δ^{56}Fe mantle source. This model not only reveals the petrogenesis of the low-δ^{56}Fe ferrobasalt and the deep origin of iron mineralization, but also provides a novel mechanism for Fe deep recycle through subduction factory. Actually, a large amount of ankerite had been found in the exhumed eclogite of the southwestern Tianshan [3], confirming that abundant Fe-carbonates had once been subducted into deep mantle.

[1] Kelley & Cottrell (2009) *Science* **325**, 605-607.
[2] Gibson et al. (2000) *EPSL* **174**, 355-374.
[3] Gao et al. (2007) *GCA* **71**, 4974-4996.