Did aqueous alteration reset radiometric ages of shergottites?

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Bouvier et al. [1] argued that most Rb-Sr and Sm-Nd mineral isochron ages of shergottites including lherzolitic were reset recently (i.e., ~180 Ma) by acidic aqueous solutions percolating throughout the Martian surface. Detailed mechanisms of aqueous alteration on the Martian surface are still not well-understood. Grady et al. [2] suggested different flows of water: surface water in contact with Martian atmosphere might be percolating downward from above and precipitation of salts could have occurred. On the other hand, groundwater from melted ice could be circulating from below and alteration of silicates could have occurred.

During aqueous alteration on the Martian surface, elemental fractionations of U, Th and REE could have occurred. Uranium and Th have similar chemical properties and show tetravalent oxidation state with similar ionic radii. Under oxidizing condition, U forms the uranyl ion which forms compounds easily soluble in water. Therefore, U becomes a mobile element and could be separated from Th which exists only tetravalent stare and whose compounds are generally insoluble in water. Large elemental fractionations between U and Th were sometimes observed during acid treatment in laboratories [3-5].

The ^{232}Th/^{238}U ($\equiv \kappa$) ratios of whole-rock samples of lherzolitic shergottites determined by IDMS are constant, i.e., 3.8-4.0 [3-5]. The REE patterns of phosphates and whole-rock samples of lherzolitic shergottites are consistent with closed-system crystallization [6,7]. Moreover, there is no detectable Ce anomaly, which is sometimes observed in aqueous alteration products. These facts suggest that abundances of lithophile trace elements were not disturbed, and that the young Rb-Sr, Sm-Nd and U-Pb ages so far reported could represent crystallization events.

References

[1] Bouvier A., Blichert-Toft J., Vervoort J.D. and Albarède F. (2005) *EPSL* **240**, 221-233.

[2] Grady M.M., Anand M., Bridges J.C.; Pearson V.K., Franchi I.A. and Wright I.P. (2005) *MAPS* **40**, #5119.

[3] Chen J.H. and Wasserburg G.J. (1986) *GCA* **50**, 955-968.

[4] Chen J.H. and Wasserburg G.J. (1993) *LPSC* **XXIV**, 275-276.

[5] Misawa K., Nakamura N., Premo W.R. and Tatsumoto M. (1997) *AMR* **10**, 95-108.

[6] Harvey R.P., Wadhwa M., McSween H.Y. and Crozaz G. (1993) *GCA* **57,** 4769-4783.

[7] Lin Y., Guan Y., Wang D., Kimura M. and Leshin L.A. (2005) *MAPS* **40**, 1599-1619.