Mn/Cr systematics: A tool to discriminate the origin of primitive meteorites?

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Until today no consensus on the classification of the Tafassasset meteorite has been obtained. It was suggested that it is: - an equilibrated CR chondrite, - a primitive achondrite and – that is has strong affinities with brachinites [1-3]. In order to lift this ambiguity and to better understand its origin, we performed a Mn/Cr isotope study of Tafassasset. For comparison we also analyzed Acapulco because only few Mn/Cr data are available on primitive achondrites.

Tafassasset: We analyzed Cr isotopes in separated minerals and in a bulk silicate fraction. The large comogenic excesses of ^{53}Cr and ^{54}Cr measured in the metal allow us to correct the other phases for potential cosmic ray effects. In the ε^{53}Cr versus ^{55}Mn/^{53}Cr space chromite, olivine and bulk silicate define an isochrone with a slope corresponding to ^{53}Mn/^{55}Mn = 3.07 x10^{-6} and an origin at ε^{53}Cr = 0.07. All Tafassasset samples exhibit a clear excess of ^{54}Cr: 1.37 ε. So far, carbonaceous chondrites represent the only meteorites that display such positive ε^{54}Cr excesses; moreover this value measured for Tafassasset is in agreement with that published by [4] for Renazzo.

Acapulco: We analyzed Cr isotopes in separated minerals and in a bulk silicate fraction. Similar to Tafassasset, the metal phase also displays large cosmogenic effects in ε^{53}Cr and ε^{54}Cr. Chromite, olivine and bulk silicate define an isochron in the ^{55}Mn/^{53}Cr versus ε^{53}Cr diagram. Zipfel [5] in a earlier Mn/Cr study on Acapulco showed that the initial ^{53}Mn/^{55}Cr ratio corresponds to 7.5 x 10^{-7}, our determination lies close to Zipfel's value (^{53}Mn/^{55}Cr =1.038 x 10^{-6}). The Mn/Cr and U/Pb closure age of Acapulco are concordant. The initial ε^{53}Cr (0.069 ε) indicates that the evolution of the Acapulco source region occurred with an eucritic Mn/Cr ratio [6]. All Acapulco minerals display an identical ^{54}Cr/^{52}Cr deficit (- 0.75 ε). This value is in agreement with the specific ratio determined for HED meteorites and it establishes the close relationship of Acapulco with this group.

Our investigation shows that the ^{53}Cr and ^{54}Cr isotope systems represent an efficient tool to decipher the origin and classification of meteorites.

[1] Bourot-Denise *et al*. (2002) *LPSC* **33**, #1611. [2] Zipfel *et al*. (2002) *MAPS* **37**, A155. [3] Nehru *et al*. (2003) LPSC **34**, #1370. [4] Trinquier *et al*. (2006) *Astr. J*. **655** , 1179-1185. [5] Zipfel *et al*. (1996) *MAPS*. **655**, 1179-1185. [6] Trinquier *et al*. (2008) *GCA* **72**, 5146–5163.

Armalcolite $(Mg,Fe)Ti_2O_5$ in the Siberian platform floodbasalts

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Armalcolite is a common mineral of the Moon basalts, whereas it is a rare mineral of the Earth rocks. It was described in lamproites, kimberlites, and some basic rocks with native iron association. We have found armalcolite in basalts of the Gudchikhinsky suite of the Norilsk Region, Siberian platform (T_1gd). These basalts are the result of early stage of trap magmatic events and are characterized by high concentration of both Ti and Fe. Armalcolite of the Gudchikhinsky basalts is Mg-poor and corresponds to ferropseudobrookite ($FeTi_2O_5$) in composition, as the end member of armalcolite solid solution. This mineral contains (n=3, EPMS, wt.%): TiO_2-64.1-71.7, Al_2O_3-0.1-0.2, FeO-23.9-28.4, MnO-0.21-0.39, MgO-0.33-1.47, Cr_2O_3-0.04-0.5 [1]. Ferropseudobrookite forms the prismatic dendrite crystals for various types of basalts. This armalcolite has very complicated microstructure that can be observed only by scanning electron microscopy method. Fig. 1 shows this armalcolite (grey) overgrown with ilmenite (light grey).

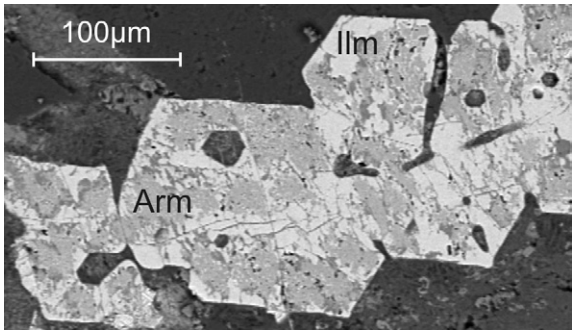

Figure 1: BSE image of armalcolite dendrite crystal.

We believe that this microstructure may be interpreted as armalcolite interaction with surrounding melt resulting in forming of ilmenite. Dendrite habit of the armalcolite crystals indicates that the melt cooled rapidly, this in turn caused incomplete replacement of primary armalcolite by ilmenite. Thus this armalcolite crystallized from high-Ti melt under reduced conditions at temperatures above 1010°C, according to experimental study of the FeO-MgO-TiO_2 system [2].

[1] Ryabov *et al*. (2001) *Magmatic formations in Norilsk region*, 600. [2] Lindsley (1991) *Rev. Miner*. **25**, 69–106.