Mn/Cr systematics in carbonaceous chondrites: Mineral isochrons versus stepwise dissolution

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The Mn/Cr isotope systematics of meteorites holds a double information: the ^{53}Cr-^{53}Mn system may be used for dating while ^{54}Cr isotope systematics yields information on the mixing of nucleosynthetically distinct components of the solar system. We present Mn/Cr data on two recently discovered carbonaceous meteorites. Sequential dissolution steps of bulk rock powder were performed but also for the first time for carbonaceous meteorites the Mn/Cr systematics were measured on separated minerals.

Tafassasset is equilibrated and recrystallized. Its minerals are metal, olivine, low Ca pyroxene, feldspar with accessory chromite and phosphate. Tafassasset's classification as a CR chondrite or a primitive achondrite is still debated [1, 2]. Chromite, olivine and bulk rock define an isochron whose slope corresponds to ^{53}M/^{55}Mn= 3.07 x10^{-6} and $\varepsilon^{53}Cr_i = 0.07$ translating into an absolute age of 4563.4 ±0.4 x10^{6} y using the LEW Cliff 86010 anchor [3]. With the exception of the first leaching step, all dissolution steps fall on a linear array. The age obtained by this procedure, 4563.6 ±1.3 x10^{6}y, is identical to the age of the mineral isochron. All samples exhibit an excess of ^{54}Cr= 1.37ε which allows us to consider Tafassasset as a metamorphosed CR chondrite.

Paris is the less altered CM chondrite known to date with affinities to CO chondrites. It contains more chondrules, refractory inclusions and metal but less matrix than the others. Forsterite, fayalite, a separate of fine-grained material attached to chondrules (presumably FGR) and an aliquot of the bulk rock were analyzed for Mn/Cr systematics. All samples fall on a line with a slope of ^{53}M/^{55}Mn = 5.582 x10^{-6} and $^{53}Cr_i$ = -0.179. This slope corresponds to an age of 4566.54 ± 0.55 x10^{6}y based on the LEW Cliff 86010 anchor [3]. All mineral fractions as well as the bulk rock of Paris exhibit a positive ^{54}Cr anomaly. In contrast, the sequential dissolution pattern is similar to that of Murchison.

The ^{54}Cr values of both meteorites fall on the correlation line that has been established between ^{54}Cr and Δ^{17}O for carbonaceous chondrites [5]. In conclusion, 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. [4] Amelin (2008) *GCA* **72**, 221-223. [5] Trinquier *et al*. (2006) *Astr. J.* **655**,1 179-1185.

Intra-cratonic lithospheric deformations — Heterogeneities, faulting and Rayleigh-Tylor instabilities

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The seismological structure of the Earth's lithosphere is identified to be strongly heterogeneous in terms of thermal and rheological properties. Lithospheric discontinuities are thought to be long lived and are mostly correlated with major tectonic boundaries that commonly have been reactivated and are subsequently the foci of magma intrusion and major mineralization. The occurrence of such variations may be caused for instance by amalgamation of micro-continents such as is thought to be characteristic of the Yilgarn, Western Australia or parts of South Africa.

This paper explores the control that 3D lithospheric heterogeneity exerts on the thermal and chemical evolution during deformation subsequent to the development of the heterogeneity, as well as periodicity and lateral distribution of phenomena such as Rayleigh-Taylor instabilities and fluid transport from the mantle through the crust. Exploration of the parameters controlling the 3D distribution of focusing mechanisms is crucial for understanding the distribution of major ore deposits along main structures. Empirical observations in Kalgoorlie area (Western Australia, Yilgran craton) show that spacing of major gold deposits is approximately 30km along major lithospheric heterogeneities. This spatial distribution may result from periodic development of Rayleigh-Taylor instabilities along the contact zone, which results in fluid transfer in areas where delamination has occurred. From numerical experiments it appears that the yield strength of the weak zone is one important parameter controlling the spatial distribution of deformation

Above the site of localised delamination of the mantle lithosphere, a series of deep crustal faults develop that may extend into the upper mantle. These deep structures can act as the pathways for mantle derived CO_2 ± H_2O fluids and alkaline igneous complexes.