

## Geochemistry of Platinum-group elements in the Kalatongke Cu-Ni sulfide deposit, Xinjiang, China

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We have analyzed 55 samples from the Kalatongke deposit for the concentrations of S, Ni, Cu and platinum-group elements (PGE) and the results are reported here. The concentrations of PGE in the sulfide mineralized samples generally increase with sulfide contents, suggesting that PGE distribution in the deposit is mainly controlled by sulfides. The concentrations of total PGE in massive, heavily-disseminated and weakly-disseminated sulfide ores are 287, 196 and 55 ppm. The average concentrations of total PGE in norite, gabbro, gabbro and diorite are 15, 12, 9 and 2 ppb, respectively.

Sulfide-bearing and sulfide-poor samples have similar mantle-normalized PGE patterns. They all have fractionated patterns characterized by depletion of Ir, Ru and Rh, and enrichment of Pt, Pd and Au. These features, together with high Cu/Ni ratios of the sulfide ores, are consistent with a highly-evolved parental magma that may have derived from a tholeiitic basalt. The Cu/Pd ratios of norite, gabbro and diorite vary from 173000 to 65710, respectively. These values are significantly higher than the typical mantle value of 6500 given by Barnes and Maier [1], suggesting previous sulfide segregation at depth. The Pd/Ir ratios of samples containing weakly-disseminated sulfides are rather restricted, mostly between 10 and 30. The Pd/Ir ratios of heavily-disseminated and massive sulfides are highly variable, ranging from 2 to 550, respectively. Significant variations of Pd/Ir ratios in these ores are consistent with fractional crystallization of monosulfide solid solution (mss) from a sulfide liquid. Ir is compatible whereas Pd is incompatible in mss [2]. Lower Pd/Ir ratios indicate higher proportions of cumulus mss in the samples.

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## Chromium nucleosynthetic anomalies in bulk and components of chondrites

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The use of short-lived radiometric systems as high-resolution chronometers for early Solar System events relies on the assumption that the Solar System has homogeneous isotopic compositions for the daughter elements and for the abundance of the parent isotopes. A recent study shows apparent correlation between  $^{54}\text{Cr}$  and  $^{53}\text{Cr}$  excess in bulk carbonaceous chondrites [1]. The variation in the former is often attributed to a nucleosynthetic origin, while that in the latter is usually assumed to reflect decay of  $^{53}\text{Mn}$ . Thus it is not clear why the two should be correlated and whether or not  $^{53}\text{Cr}$  variability partially reflects a nucleosynthetic origin. These are important questions especially because the  $^{53}\text{Mn}$ - $^{53}\text{Cr}$  extinct nuclide system has become an increasingly useful and widely applied cosmochronometer. Identifying the  $^{54}\text{Cr}$  carrier phase will assist in addressing the relationship, if any, of  $^{54}\text{Cr}$  and  $^{53}\text{Cr}$  variability.

To address these issues, we report here Cr isotope analyses of leachates at various temperatures of acid residues of carbonaceous, ordinary and enstatite chondrites. We also address the issue of Cr nucleosynthetic anomalies in bulk carbonaceous chondrites where incomplete dissolution of refractory presolar grains can be a problem.

The leachates of acid residues of Murchison (CM) show large excess in  $\epsilon^{54}\text{Cr}$ . The excess increases from 36 to 77  $\epsilon$  when the leach temperature increases from 60 to 80°C, but remains constant when the temperature increases to 90°C. The leachates of carbonaceous chondrites from various subgroups show similar excesses (70 to 200  $\epsilon$ ) at 80°C, indicating a common Cr-anomaly carrier. In contrast, the leachates of enstatite chondrites show very small or no anomaly in  $^{54}\text{Cr}$ . Our preliminary results for two flux-fused bulk carbonaceous chondrites show excesses in  $^{54}\text{Cr}$  of  $\sim 1$   $\epsilon$ , consistent with previous work [2]. However, neither of them show resolvable deviation from the terrestrial standard in  $^{53}\text{Cr}$ .

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## Geochronological and geochemical constraints on petrogenesis of Late Mesozoic I- and A-type granites from the coastal area of northeastern Fujian Province, SE China

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Late Mesozoic granitic plutons of I-type and A-type coexist in the coastal area of northeastern Fujian Province, SE China. In this study, we dated four I-type plutons (Nanzhen, Dacengshan, Sansha and Dajing) using LA-ICP-MS zircon U-Pb method with ages of  $96.1 \pm 2.7$ ,  $93.1 \pm 2.4$ ,  $91.5 \pm 1.5$ ,  $93.8 \pm 1.8$  Ma, respectively. Two A-type granites (Yaokeng and Taimushan) show similar or slightly younger ages of  $91.3 \pm 2.5$  and  $92.8 \pm 0.6$  Ma. Geochemically, the A-type granites show higher  $\text{SiO}_2$ ,  $\text{FeO}^*$ , Nb, Zr, Hf, Ga, Rb/Sr, Rb/Ba and Ga/Al, but lower  $\text{Al}_2\text{O}_3$ , MgO, CaO,  $\text{P}_2\text{O}_5$ , Sr, Ba, and less fractionated REE patterns with more pronounced negative Eu anomalies than those of the I-type rocks. The  $\text{K}_2\text{O} + \text{Na}_2\text{O}$  contents decrease with increasing  $\text{SiO}_2$  from I-type to A-type granites, and no distinct fractional crystallization trend has been documented on the Harker diagrams. Geochemical modelling indicates that the I-type and A-type granites evolve along different trends. Zircon saturation temperatures of the A-type granites ( $816\text{--}921^\circ\text{C}$ ) are clearly higher than that of the I-type ( $730\text{--}779^\circ\text{C}$ ). These data suggest that the A-type granites could not be generated by fractional crystallization from the I-type magma.

The A-type granites show a significantly higher  $\varepsilon_{\text{Nd}}(t)$  values ( $-0.65$  to  $-1.39$ ) than the I-type rocks ( $-4.20$  to  $-5.49$ ), which also can not be explained by the fractionation model as the Nd isotopic compositions are scarcely changed during fractional crystallization. The higher  $\varepsilon_{\text{Nd}}(t)$  values of the A-type granites require a higher proportion of mantle input in their generation process. We therefore conclude that the I- and A-type granites have different sources, and have underwent different rock-forming process.

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## Carbonate weathering in response to monsoon changes

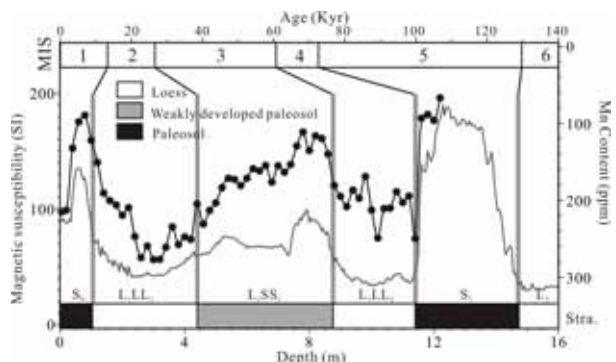
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Chinese loess-paleosol sequences are valuable archives for the response of carbonate weathering under long-term evolutions of East Asian monsoon system. However, the precipitation of secondary calcite caused difficulty in quantifying the weathering of carbonate in loess by its content.

The weathering of detrital calcite in loess deposits may be reconstructed by the amount of Mn bonded in calcite, since it is characterized by extremely high Mn content ( $\sim 2000$  ppm) while the authigenic carbonate shows very low Mn content. Thus, the dissolution of detrital calcite in loess will be reflected by decrease of calcite-bonded Mn no matter how much the secondary calcite are precipitated. Here, the calcite-bonded Mn are released by acetic acid leaching ( $0.2$  mol/L) over 12h and then measured on an ICP-AES. Repeated experiments show that the uncertainty associated with the whole procedure is  $\pm 5.1\%$  (standard deviation,  $n=5$ ).

Weak dissolution of calcite in  $L_1LL_1$  and  $L_1LL_2$  loess layers is indicated by high Mn content, corresponding to the weak summer but strong winter monsoon condition in marine isotopic stage 2 and 4, while intensive calcite weathering with strong summer but weak winter monsoon in  $S_0$ ,  $L_1SS_1$  and  $S_1$  layers (MIS1, 3, 5) is indicated by low Mn content (Fig. 1). We propose that the winter monsoon influences the weathering of calcite through controlling the weathering time (sedimentation rate), while the summer monsoon achieves its influence by changing the precipitation amount.



**Figure 1:** Variations of calcite bonded Mn content and susceptibility changes in upper part of loess-paleosol sequence.

## Decompressional contamination of granite, Lachlan Orogen, Australia

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### Postulate

Decompression can assist assimilation of meta-sediment by granites at higher crustal levels.

### Background

S-type granites in the Lachlan Orogen, SE Australia contain a substantive primitive component [1] and can, in some cases, be related to discrete, migmatitic, high-T and low-P (ca. 700 - 750°C; 2.5 - 4 kbar) meta-sedimentary complexes [2,3]. Richards and Collins [2] inferred open-system or "transfer-zone" characteristics in one such complex, the Cooma Metamorphic Complex (CMC), with respect to proximal S-type granites and Healy *et al.* [3] illustrated a transition from I- to S-type chemistry approaching the CMC, alluding to proximal contamination of initially I-type magma. These points have been expanded by considering phase relationships in the CMC and near-anhydrous high-T, low P metapelitic enclaves in the unrelated S-type Cowra Granodiorite (CG).

### Critical Observations and Inferences

Melt-present decompression textures can be inferred within the near-anhydrous metapelitic enclaves of the CG and within the CMC. Metapelitic enclaves in the CG are dominated by cordierite + sillimanite + spinel, separated from relict biotite and garnet porphyroblasts by cordierite. In the CMC; (1) cordierite and ilmenite replace relict sillimanite + biotite and (2) tourmaline overgrows sillimanite adjacent to leucosome. Cordierite and ilmenite-bearing parageneses indicate decompression from ca. 4 kbar to ca. 2.5 kbar whilst tourmaline-bearing parageneses indicate the involvement of B and late-stage melt in the CMC. B-absent, phase diagram calculations (after [4]) indicate both depression of the solidus to lower temperatures and significant melt generation (ca. 15-20 mol%) during near-isothermal decompression within that pressure range, thus assisting the assimilation of sediment.

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## Heterogeneity of the protoplanetary disk? The case of $^{60}\text{Fe}$ and beyond

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Excesses of radiogenic  $^{60}\text{Ni}$  were first detected in the 90's [1]. More recently many attempts have been made to apply the  $^{60}\text{Fe}$ - $^{60}\text{Ni}$  chronometer to various objects, with ambivalent results: while excesses and deficits in  $^{60}\text{Ni}$  are indeed observed in some meteorites [e.g. 2-6], no consistent chronology emerges so far from all available data. The meaning of the excesses and deficits is debated, all the more because anomalies have also been reported for other Ni isotopes [4, 6, 7]. In some cases, Ni anomalies are correlated with other isotopes like  $^{54}\text{Cr}$  [6] or  $^{96}\text{Zr}$  [7] suggesting a nucleosynthetic origin and precluding the use of the  $^{60}\text{Fe}$ - $^{60}\text{Ni}$  system as a reliable chronometer.

To follow up our previous work on Ni isotopes, I analyzed ureilites and CB chondrites. Besides angrites, CB chondrites represent another good anchor to map short-lived chronometers onto an absolute timescale. The CB chondrite and ureilite results taken together with data previously obtained on eucrites, angrites, iron meteorites, chondrules and CAIs confirm that the Fe-Ni system cannot be used as an ubiquitous short-lived chronometer. It appears instead that  $^{60}\text{Fe}$  was most likely heterogeneously distributed in the early solar system and that the latter was characterized by at least two isotopically different reservoirs, in good agreement with the heterogeneity already proposed for other elements [e.g. 8, 9]. An imperfect mixing of multiple nucleosynthetic sources is however difficult to reconcile with the conclusions of Boss [10] who calculated that radionuclides homogenized almost completely within 1000 years. The constraints brought by the meteorite data on the stellar environment of the sun's birth as well as the solar nebula dynamics will be discussed at the conference.

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