Mesoproterozoic and Paleoproterozoic igneous crust of central East Antarctica: Age and origins revealed from glacial clasts

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New SHRIMP U-Pb zircon ages from a large suite of granitoid clasts collected from glacial catchments draining central East Antarctica show that the crust in this ice-covered region was formed by a series of magmatic events at 2.00-1.90, 1.88-1.85, 1.80-1.79, 1.57, 1.48-1.43, and 1.20-1.10 Ga. The dominant granitoid populations are 1.85, 1.45 and 1.18 Ga, with some showing metamorphic overprinting at 1.18-1.15 Ga. Together, these clast ages indicate the presence in cratonic East Antarctica of a large, composite Proterozoic igneous province that reflects crustal growth across central East Gondwana. Further, they provide direct geologic support for the SWEAT reconstruction of Rodinia by correlation with Laurentia. Abundant ~1.1 Ga igneous and metamorphic clasts indicate the presence of Grenvillian orogenic belts in the interior that may reflect Rodinia assembly, and may sample crust underlying the Gamburtsev Subglacial Mountains.

In addition to U-Pb ages, we determined zircon Hf and O isotopic compositions in order to evaluate crustal history. Hf-isotope compositions were determined simultaneously with U-Pb by LA-ICP/MS in split-stream mode (LASS); O-isotope compositions were measured on SHRIMP-II in negative ion mode. Among the granitoid age populations, the following trends emerge: (1) a general pattern of increasing $\delta^{18}O$ with decreasing εHf, both corresponding with increasing age; (2) granitoids of ~2.0 Ga age have weakly evolved Hf compositions (εHf = +1 to +4) and mantle $\delta^{18}O$; (3) rocks of ~1.57, ~1.79 and ~1.88-1.85 Ga age show evolved crustal compositions with εHf = +5 to -8, and $\delta^{18}O$ = 5.8-8.3 ‰, and the ~1.88-1.79 Ga granitoids require some involvement of Archean crust; (4) rocks of 1.50-1.45 Ga age have mantle signatures with εHf = +5 to +11; and (5) rocks of ~1.2 Ga age have crustal $\delta^{18}O$ signatures and εHf = +2 to +5. Together, these age and isotopic data provide the first glimpse of crustal growth in central East Antarctica and suggest a varied history of relatively juvenile Proterozoic magmatism.

^{54}Cr isotope anomalies and Mn/Cr chronology in chondrites

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In order for Cr to be used as a chronometer, the initial homogeneity of its isotopic composition in the solar system has to be verified. Today we have clear evidence for anomalies of ^{54}Cr in different meteorites whereas evidence for heterogeneity of ^{53}Mn and ^{53}Cr is less obvious [1-4].

In order to assess this problem we have performed detailed internal isotopic and mineralogical investigations of recently discovered equilibrated meteorites related to CR chondrites (Tafassasset, NWA 6901), the carbonaceous chondrite (NWA 5958) and of Acapulco. We exploit the double information provided by the Mn/Cr system: dating with ^{53}Mn/^{53}Cr and information on the nucleosynthetically distinct components witnessed by ^{54}Cr.

The bulk rocks of Tafassasset, NWA 6901 and NWA 5958 show positive ^{54}Cr values (1.333 ± 0.126, 1.007 ± 0.188, 0.973 ± 0.153) that are typical for carbonaceous chondrites. In contrast the Acapulco bulk rock exhibits a negative ^{54}Cr anomaly, similar to that observed in achondrites. The mineral phases in Tafassasset (chromite, olivine) exhibit an identical ^{54}Cr excess, while the ^{54}Cr anomaly is variable in different minerals (clinopyroxene, chromite, olivine) of Acapulco. In the ^{55}Mn/^{52}Cr versus ε^{53}Cr diagram the samples of both meteorites fall on linear trends implying variable ^{53}Mn/^{55}Mn ratios that are consistent with well-established chronological information [5, 6].

We will discuss the significance of such internal Mn-Cr isochrons, compare them to age information obtained from other systems and evaluate the new data in respect to the initial heterogeneity of ^{53}Cr and ^{54}Cr of the solar system.

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