New developments in AMS - what is the impact to earth sciences?

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Recent developments made in accelerator mass spectrometry (AMS) by the Zurich AMS group in collaboration with National Electrostatic Corp. (NEC), have demonstrated that small and compact instruments can be built for radiocarbon dating. These instruments are based on accelerators operating at terminal voltages of a few hundred kV. Meanwhile NEC has developed a commercial product. Customers have demonstrated that these facilities have a performance which is almost equivalent to the larger facilities (e.g. http://www.radiocarbon.pl/), however they require much less investment and have lower operating costs.

The AMS group in Zurich is presently exploring the potential of this type of small facility for the analysis of other long-lived radionuclides such as ^{10}Be, ^{26}Al, ^{41}Ca,^{129}I and ^{239,240,242,244}Pu. Of special importance for earth sciences are ^{10}Be and ^{26}Al for exposure dating. Similar yields compared to larger facilities have been obtained. The main problem is the background. In case of ^{10}Be, the ^{10}B is the main source of background. Various schemes for the elimination of this background are under investigation. In case of ^{26}Al, various molecules of mass 26 cause problems. The present status of this investigation as well as the prospects of applications in earth sciences will be discussed.

Presence of evolved continental crust in Archean Pilbara craton, Western Australia: Evidence from Re-Os isotopic systematics of 3.4Gyr cherts

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It is not yet well known when the Earth's crust began to form emergent landmasses and how it has evolved. Isotopic data for cherts in Archean greenstone belts provide key constraints on crustal evolution in the early history of the Earth, because cherts include crustal and oceanic components in their deposition on the sea floors. Here we imply the existence of evolved continental crust in Australia at 3.4 Gyr, based on Re-Os isotopic data at Marble Bar, Pilbara, western Australia.

The ^{187}Re/^{188}Os and ^{187}Os/^{188}Os data from three chert samples plot on a 3.4 Gyr reference line with an initial ^{187}Os/^{188}Os ratio of 0.85, which is much higher than that of the 3.4 Gyr chondritic mantle (0.103). The extremely high initial Os ratio estimated indicates that the Marble Bar cherts formed from a large amount of continental crust material, which make us expect that the evolved continental crust already existed in the Pilbara area at 3.4 Gyr.

Minami et al. (1995) obtained a Sm-Nd age of 3.2±-0.3 Gyr with initial _Nd of +1.0±3.0 for banded cherts, which is in the range of that of depleted or chondritic mantle. Therefore, they suggested large contribution of hydrothermal solution derived from mantle to the cherts, which is incompatible with the Re-Os results. This inconsistency may be due to insignificant evolution of ^{143}Nd/^{144}Nd in the early Earth. Difference in geochemical behavior between Re (slightly incompatible) and Os (strongly compatible) leads to large Re/Os fractionation during mantle melting, which results in high crustal ^{187}Re/^{188}Os ratio and hence rapid ^{187}Os/^{188}Os evolution. Our results further demonstrate the effectiveness of Re-Os studies on Archean rocks for early crustal evolution.