Performance of a multicollector mass spectrometer for heavy noble gas analysis

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Noble gases are key tracers for the origin of volatiles in the terrestrial planets and of interaction between mantle reservoirs and the atmosphere. General consensus is that material accreting in the solar nebula and nebula gases from the Sun itself were incorporated into the terrestrial planets, providing a starting point for models of planetary evolution. However, the precise starting composition of terrestrial noble gases is a matter of much debate.

A similarity has been observed previously [1, 2] between the average composition for solar wind Ne implanted into meteorites and that of the Earth's mantle, suggesting a link between the two. However, Genesis data presented in [3] has recently shown that the average meteorite value is due to implantation fractionation and sputtering over the age of the solar system, which may be difficult to reconcile with solar wind Ne implanted very early in Earth history. Ne isotopes alone cannot resolve this problem. Therefore we turn to Ar, Kr and Xe.

Recent acquisition of a multi-collector noble gas instrument (GV Helix) promises to deliver improvement in precision by at least an order of magnitude over single collector instruments. At present the spectrometer is operating with 5 Faraday bucket collectors and 10^{12} ohm resistors. Mass resolution is ~1000 for all collectors and peaks are flat to 1 part in 5000 over 300ppm of peak top. This allows determination of isotopic compositions with the highest possible precision. In Faraday only configuration, applications are limited to identifying minor isotopic fractionation processes and different volatile sources where sample size is not an issue and hence all isotopes can be measured on Faraday detectors e.g. well gases, ocean and groundwaters. Initial Xe data achieves ~2 permil day to day precision on an isotope ratio with a 10mV (1×10^{-14} A) beamsize for the minor isotope. We will expand the dataset to show the precision and reproducibility achieved thus far for all heavy noble gases.

[1] Trieloff *et al.* (2000) *Science* **288**, 1036-1038. [2] Ballentine *et al.* (2005) *Nature* **433**, 33-38. [3] Grimberg *et al.* (2006*) Science* **314**, 1133-1135.

Formation of new continental crust in Western British Columbia during transpression and transtension

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Crustal growth in the Coast Mountains, along the leading edge of the Canadian Cordillera, was the result of processes associated with horizontal flow of material during transpression and subsequent transtension, and the vertical accretion of mantle derived melts. From 85 to 58 Ma, as exotic terranes were translated northward during transpression, the crust was thickened to about 55 km, and melt that originated from a mix of mantle-derived basalt with partial melt of the thickened crust intruded into crustal scale transpressive shear zones. When the orogen extended, between 58 and 50 Ma, there was large-scale decompression melting in the mantle and dehydration melting in the lower crust. Voluminous emplacement of sub horizontal sills facilitated by ductile flow of the gneissic country rocks partially filled space created as the crust was pulled apart and as 15 to 20 km of tectonic exhumation occurred across low angle normal ductile shear zones. By 50 Ma, the final crustal thickness of the new continental crust was about 34 km. Comparison of seismic data with other crustal sections suggests that the crust-forming processes identified in western British Columbia have general applicability to models for the formation of continental crust.