Constraints on crustal evolution from Rb/Sr and contemporary erosion

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This contribution addresses two aspects pertinent to models for the generation and evolution of the continental crust; the composition of new/juvenile continental crust and how that changed with time, and the tendency for relatively young continental crust to predominate in areas of high relief. The former constrains the conditions and the tectonic setting(s) in which the continental crust was generated, and the latter results in an under-representation of old continental crust in the sedimentary record. The composition of the new continental crust is estimated from the time-integrated parent/daughter ratios of isotope systems in crustal melts derived from that new crust. ^{87}Rb decays to ^{87}Sr with a long half-life (~48.8 Ga) compared to the age of Earth, and because of the different partitioning characteristics of Rb and Sr within the crust ($D^{Rb} < D^{Sr} << 1$), crustal differentiation processes produce a large range of highly fractionated Rb/Sr ratios. As a consequence there is a positive correlation between the Rb/Sr and both the SiO_2 content and the thickness of continental crust along active continental margins. Thus the time-integrated $^{87}Rb/^{86}Sr$ ratio can be used as a proxy for the bulk composition and the thickness of new continental crust back in time.

The time-integrated Rb/Sr in crustal material with crust formation ages ranging from the Hadean to the Phanerozoic suggest that new continental crust was principally mafic over the first 1.5 Ga of Earth's evolution. The composition of new crust became more evolved from 3 Ga to 1.5 Ga and the estimated thickness of the crust in areas where new crust was generated increased by a factor of 2 over that period. At the present day there is a marked negative array between topographic relief and the model Nd age of different terrains as predicted in a number of studies over the last 30 years (e.g. Allègre and Rousseau, 1984 [1]; Dhuime et al. 2012 [2]). The under-representation of old crust therefore needs to be an integral part of models evaluating the evolution of the continental crust from the sedimentary record.

[1] Allègre & Rousseau (1984) *Earth Planet. Sci. Lett.,* **67**, 19-34. [2] Dhuime *et al* (2012) *Science* **335**,1334-1336