A new look at the Nd isotopic record of sedimentary rocks through Earth's history

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Detrital sediments concentrate the erosion products of continents, hence naturally average the composition of large continental areas. In the 1980's, several studies have used the Nd isotopic composition of sediments as a proxy to study the formation and evolution of the continental crust through geological time (see for example the pioneer study of Allègre and Rousseau, EPSL, 1984). This work led to the development of various crustal growth models and showed that modern upper continental crust had an average age of 1.5 – 2.0 Ga, hence was mostly made of reworked crust and only very little juvenile material.

I here re-visit the Nd isotopic record of worldwide detrital sediments based on a compilation of more than 2,000 published data to see whether the present-day database could provide more constraints on the composition and evolution of the continental crust through time. The compilation gathers Nd data for both fine- and coarse-grained sedimentary rocks from 3.8 Ga to present-day. It shows that provenance information slighly varies as a function of sediment grain-size, hence that erosion processes and mineral sorting during sediment transport can bias the sedimentary record. First-order observations indicate no significant variation of the sediment Sm/Nd ratio through time. This suggests that the average composition of the crust exposed to weathering has not drastically changed since the Early Archean. The initial Nd isotopic composition of sediments smoothly decreases towards unradiogenic compositions to reach its present-day average value of $\varepsilon_{Nd} \sim -10$. In contrast, the average age of the eroded crust increases through Earth's history. Both the Nd isotopic composition and the age of the eroded crust follow a first-order linear evolution through time. No major change of slope is observed from 3.8 Ga to present-day. At the second order however, peaks towards more radiogenic Nd isotopic compositions can be identified at specific periods of time. The latter excursions may correspond to episodes of enhanced erosion of juvenile crust through Earth's history.