Testing models for Continental crustal growth: A TerraneChron® approach

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The question of the rate at which the continental crust had grown through time has divided geologists for many years. Some believe that most, or all, of the continental crust was formed early in Earth's history and has been largely recycled ever since [1]. Other models suggest episodic growth in which the volume of depleted mantle increases with time in a stepwise manner, and is linked to major episodes of continental crust formation at 3.6, 2.7 and 1.8 Ga [2]. A more recent model [3] argues that these pronounced peaks in crustal ages reflect differences in the preservation potential of crustal rocks and do not represent episodes of enhanced crustal generation.

A worldwide compilation of over 14,000 TerraneChron® (integrated U-Pb, Hf-isotope and trace-element analyses) analyses of zircon, largely from detrital sources, collected at GEMOC since 2000 emphasises the important difference between 'age peaks' and episodes of 'crustal generation'. The age data alone would support an 'Episodic Growth' model, but the Hf-isotope data reveal that most of the magmatic rocks represented in the major 'episodes' were derived by the recycling of pre-existing crust, especially after ca 2.5 Ga; the juvenile contribution represents a small proportion of most magmatic episodes. Modelling of the ages of the recycled components emphasises the repeated reworking of Archean components, supporting an 'Early Growth model'.

[1] Armstrong (1991) *Aust. J. Earth Sci.* **38**, 613-630.
[2] Condie (2000) *Tectonophysics* **322**, 153-162.
[3] Hawkesworth *et al.* (2009) *Science* **323**, 49-50.

The influence of dissolved SiO_2 on calcite recrystallization rate

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Calcite crystals in chalk are smaller than expected, considering the long time available for recrystallization. Studies have shown that many compounds can inhibit calcite dissolution and precipitation but there is little previous work on recrystallisation rates. In this study, we were interested in determining rates in the presence of dissolved silica. We monitored recrystallization using ^{14}C as a tracer. The removal of ^{14}C from aqueous solution during isotope exchange between $HCO_3^-{}_{aq}$ and solid calcite can be used for calculating the amount of recrystallized calcium carbonate.

We used calcite-equilibrated solutions with pH=8.3, I=0.1 M (NaCl), with and without dissolved SiO_2 (10 mg/L, 60 mg/L and 180 mg/L). Solid to water ratio was 50 g/L, the duration of the experiments was approximately 3 months.

The mass of newly formed calcite was derived using formula adapted from Curti *et al.* [1]. Calcite recrystallization rates are listed below. The deviation of the rates varied, depending on conditions and was not higher than 15%.

	Silica-free system	In presence of $SiO_{2(aq)}$ (10 mg/L)	In presence of $SiO_{2(aq)}$ (60 mg/L)	In presence of $SiO_{2(aq)}$ (180 mg/L)
Fast step	10×10^{-11}	9×10^{-11}	8×10^{-11}	10×10^{-11}
Slow step	8×10^{-12}	5×10^{-12}	9×10^{-12}	5×10^{-12}

Table 1: Calcite recrystallization rates (mol m^{-2} s^{-1}) for various silica concentrations.

In all experiments, there were two steps of uptake: an initial, rapid adsorption, followed by slower uptake by recrystallisation. This agrees well with previous reports. From the recrystallisation rates (above), it can be concluded that the presence of dissolved silica has negligible effect on calcite recrystallization.

[1] Curti *et al.* (2005) *Geochimica et Cosmochimica Acta* **69**, 1721-1737.