Geophysical Research Abstracts, Vol. 8, 04326, 2006
SRef-ID: 1607-7962/gra/EGU06-A-04326

Episodic growth of continental crust

A. Davaille (1), N. Arndt (2)

(1) IPG-CNRS UMR 7154, 4 Place Jussieu, 75252 paris cedex 05, France, (2) OSUG, Univ de Grenoble. BP 53, Grenoble cedex 38401, France (Contact : davaille@ipgp.jussieu.fr, Nicholas.Arndt@ujf-grenoble.fr)

The distribution of U-Pb ages of zircons in granites and large rivers provides a record of three-stage, episodic growth of the continental crust. The first stage, from 2.7 to at least 4.0 Ga, was one of continuous growth without prominent peaks. The second stage, from 1.8 to 2.7 Ga, was dominated by large peaks of crustal growth separated by long troughs when little crust formed. The largest peak at 2.7 Ga was global; smaller peaks at 2.5, 2.1 and 1.8 Ga are of more restricted extent. During the current plate-tectonic-dominated stage, from 0 to about 1.8 Ga, growth was semi-continuous but punctuated by large peaks like the 1.1 Ga Grenville orogeny. Individual peaks have a distinct internal structure. They open with abundant plume-derived mafic-ultramafic volcanism and climax 30 m.y. later with intrusion of voluminous granitoids that probably formed in subduction zones. Each peak therefore started with enhanced plume activity and finished with accelerated plate tectonics. Then followed a period of little activity.

Using fluid mechanics constraints, we explain the three-stage evolution of the earth and the pronounced peak-and-trough pattern of the second stage. The first stage corresponds to cooling from above by plate tectonics of a mantle whose lower 500 km were initially stratified in density. The huge 2.7 Ga event marks the sudden global destabilization of this hot sublayer, producing hot thermochemical domes and oceanic plateaus. Increased mantle temperature initially accelerated the subduction of pre-2.7 Ga oceanic crust producing the peak in continent growth. The high mantle temperature also produced new much thicker crust that resisted subduction, resulting in a period of reduced activity. Laboratory experiments show that thermochemical doming, a form of mantle convection, can be episodic at one site but chaotic on the global scale. This explains the plume plus plate-tectonic regime in the third, most recent stage.