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When hot thermochemical instabilities trigger subduction and continental growth : the episodic Earth history.

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Cratons generation often starts with massive mafic-ultramafic volcanism, to climax about 30 m.y. later with intrusion of voluminous granitoids. In terms of mantle dynamics, the first episode could be created by a mantle plume, while the second corresponds to subduction. To understand this sequence of events, we have studied the circulations induced by the onset of thermochemical hot instabilities at the bottom of the mantle, using laboratory experiments. A strongly temperature-dependent viscosity fluid, glucose syrup, was used. Initially a thin layer of syrup, made denser by the addition of salt , was at the bottom of the tank. Then the tank was heated from below and cooled from above. The temperature and velocity fields were measured in situ using thermochromic liquid crystals and PIV. The experiments were run for low buoyancy numbers, in the regime where episodic hot thermochemical doming occurs. The presence of denser material at the bottom of the tank delays the onset of hot instabilities, and convection usually starts by cold downwellings. Then hot domes develop from the hot chemically denser layer, with a morphology of cavity plumes since they are less viscous. When they hit and spread under the top surface, they peel off the cold thermal boundary layer there. This triggers a ring of enhanced cold instabilities around each thermochemical dome. The velocity of the cold downwellings is significantly increased compared to its value in absence of domes. This period of enhanced downwellings is however followed by a lull, during which the cold thermal boundary layer is growing again. Using scalings laws derived from the experimental data, we propose that this sequence of events is similar to what is observed on Earth. Moreover, the experiments predict that such continental growth should be episodic, the onset of the first thermochemical instabilities, synchroneous on the whole mantle, generating

a huge peak of continental growth, and being followed by several more disorganized ones. U-Pb ages of zircons in granites and large rivers seem to agree with this story.