Geophysical Research Abstracts
Vol. 13, EGU2011-2045-1, 2011
EGU General Assembly 2011

A key element to unravel the formation of continental crust

Eason Hong and Wei-Ting Kao
National Taiwan Ocean University, Applied Geosciences, Taipei, Taiwan (eason@mail.ntou.edu.tw, +886-2-2462-5038)

Two of the most important and yet longstanding issues in earth science are when plate tectonics did begin as well as how the continental crust was formed in the early earth history. Forming a harden crust on the earth's surface is a prerequisite for plate tectonics. And yet, increasing models now integrate plate tectonic and related process to interpret the formation and evolution of the continental crust.

As to the time of onset, Hamilton (1998) and Stern (2008) proposed that modern-style plate tectonics only operated in late proterozoic time, by 0.8-1 Ga. However, de Wit (1998) suggested that modern plate tectonic probably has its root far back to the Hadean- Archean transition between 4.0 and 4.2 Ga. Harrison et al. (2005) also erected evidence for the existence of continental crust at 4.4 to 4.5 Ga. implying the operation of plate tectonics occurred in Hadean time. As the first formed earth is hotter with more vigorous mantle convective movement, a few studies favored a predominantly vertical mantle upwelling and/or plume diapirism along with delamination or sagduction rather than lateral movement of plates for pre-plate-tectonic setting.

Furthermore, another crucial question is when an ocean existed for the plate tectonics operated beneath it. de Wit (1998) pointed out that the production of granitoids become possible only after the existence of an hydrosphere which he believes to accumulate on earth surface by about 4.0 Ga. Later on, based on Ti-thermometry, oxygen isotope data and trace element compositions, early Hadean Oceans were proposed to exist even earlier by 4.3 to 4.4 Ga. The existence of an Hadean hydrosphere implies a underlying hardened crust, prerequired for plate tectonic process to operate, was formed even earlier or at least contemporaneous on earth's surface.

Due to the higher-temperature setting, the newly formed primitive crust is reconcilingly concluded to be basaltic crust. While plate tectonics proceeded, there are magnificent continents dominating almost one-third of the present earth surface. Hence, when and how the continent formed amaze and attract lots of researcher for many decades.

Recently, arc magmatism, rising plume, subducted plate and intracrustal melting models as well as a few others were proposed. In general, most of the models suggest that partial melting of wet subducting slab or remelting and fractional crystallization of the lower intra crust are required to induce intermediate to silicic melts and leave the eclogitic residue sinking back into mantle (delamination). These explanations seem appealing. However, there are problems remain unsolved.

Summarized from the above findings, a few conclusions can be drawn as follows: a juvenile basaltic crust once formed on earth surface was soon covered by an early Hadean Ocean. The coexistence of the litho- and hydrosphere indicates that modern plate tectonics already operated below the sea-level in Hadean time. Meanwhile, both of the ocean and plate tectonics are thought particularly pertinent to the formation of the continental crust. Under such consideration, a key element is recognized and a new proposition of the continental crust formation will be presented.