2006, *Oceanography* 19(4):104–112, http://dx.doi.org/10.5670/oceanog.2006.09

Manufacturing Continental Crust in the Subduction Factory

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First Paragraph

Subduction zones have been consuming oceanic lithosphere since the dawn of plate tectonics on this planet (Figure 1). Raw materials such as pelagic and terrigenous sediments, altered and fresh basaltic oceanic crust, and lithosphere are conveyed into this "factory" as the subducted plate sinks deeper into the mantle. Assuming steady-state subduction of the entire 7-km-thick oceanic crust for 3 billion years, the accumulated crustal materials occupy ~ 10 percent of the lower mantle. Aqueous fluids and/or silicate melts that are progressively extracted from these raw materials through dehydration reactions and/or partial melting during subduction dissolve particular elements and carry them into the overlying mantle wedge, leading to generation of chemically distinct arc magmas that differentiate, solidify, and produce juvenile arc crust; the site of these transformations is known as the "subduction factory." Collisional coalescence and magmatic thickening of juvenile arcs ultimately yield continental crust, an important subduction-factory product. The factory inevitably emits waste materials, such as chemically modified, residual oceanic crust and sediments and delaminated arc mafic (high in iron and magnesium) lower crust, which sink deeper into the mantle. These waste materials, because of their great mass and residual crustal composition, contribute greatly to the thermal and chemical evolution of the mantle and ultimately may return to Earth's surface as mantle plumes and related magmas (Figure 1).

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Citation

Tatsumi, Y., and R.J. Stern. 2006. Manufacturing continental crust in the subduction factory. *Oceanography* 19(4):104–112, http://dx.doi.org/10.5670/oceanog.2006.09.

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Oceanography Magazine, The Oceanography Society, P.O. Box 1931, Rockville, MD 20849-1931, USA
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