Comment and Reply
An alternative Earth, Warren B. Hamilton, GSA Today, v. 13, no. 11, p. 4–12.

Comment

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Since 1988, Warren Hamilton has crusaded against the widespread acceptance of uniformitarianism in the Archean and raised some valid concerns; most notably that Archean crust shows many significant differences to post–2.0 Ga crust formed in plate subduction-accretion zones (Hamilton *in* Reed et al., 1993; Hamilton, 1998). But his "Alternative Earth" model (Hamilton, 2003), in which he states that "Plate tectonics did not operate within preserved Archean crust," or " before 2.0 Ga," and that "Plumes do not exist," mirrors the 1980s Earth evolution models based on the first description of a ca. 2.0 Ga Wilson cycle in the Wopmay orogen (Hoffman, 1980) and is based on selective criteria that ignores a wealth of compelling multidisciplinary geological evidence in support of Archean plate tectonics (e.g., Friend et al., 1988; Calvert et al., 1995; White et al., 2003) and mantle plumes (e.g., Lawver and Muller, 1994; Wolfe et al., 1997; Bijwaard and Spakman, 1999). Geological processes operative over the 2 G.yr. Archean Era (4.5–2.5 Ga) were diverse (Van Kranendonk, 2004, and references therein) and included impact tectonics (Glikson, 2001), non-uniformitarian tectonics including the *local* partial convective overturn of crust (Collins et al., 1998) and possibly the mantle (Davies, 1995), *and* plate tectonics that was probably characterized by shallow subduction in its early stages (pre–3.3 Ga: Smithies et al., 2003) and evolved to steeper subduction from ca. 3.1 Ga (Smithies et al., 2004). No one can argue that secular processes have not affected the Earth, even over the past 2 G.yr., and it is the relationship between the range of tectonic processes that has changed over time. Perhaps it is now Hamilton who needs to adopt a broader view.

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Reply

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Martin Van Kranendonk (to whom I am indebted for a superb Pilbara field trip) and Kevin Cassidy have much company in arguing that plate tectonics operated during Archean time. Archean plate rationales satisfy uniformitarian assumptions but appeal to processes that left no clear field evidence. No one has demonstrated that trailing-edge stratal sequences were deposited on sundered cratons, which were then rotated and recombined with accretionary and oceanic debris caught in sutures, or that magmatic arcs, thrust belts or crustal thrusts, or other products of plate convergence and collision were developed. When I began looking at Archean geology, I expected to find some semblance (hotter, smaller, faster?) of the products of Phanerozoic plate tectonics with which I had long worked in western North America, Eurasia, and Indonesia, and surrounding regions—but no semblance is there.

Plumes from deep mantle? All tectonic, petrologic, geochemical, and modeling rationales are circular and are only made more complex and ad hoc as their assumptions and predictions are disproved. Tomography? Even advocates Wolfe et al. (2002) claimed to see a plume down only to 400 km, which is not at issue. Bijwaard and Spakman (1999) presented an eye-catching cross section in the only place in a poorly constrained model where continuity, however irregular, could be depicted, saturated it with colors that made small deep "anomalies" look like large upper-mantle ones, and truncated it at both ends to omit "plumes" under flanking cratons. Supposed plume images claimed for finite-frequency tomography also are suspect.

I reaffirm my message. Subtract bad and weak assumptions, add multidisciplinary data, and Earth's evolution and behavior can be read as startlingly different from the standard model.

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Comment

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