When did the life of plate tectonics begin?

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The question of when plate tectonics began, and in particular whether it began in the Archean, is the focus of several recent articles (e.g., Cawood et al., 2006; Witze, 2006) and a recent GSA Penrose Conference (Condie et al., 2006). I support the idea that “modern-style” plate tectonics “evolved” from an earlier form of proto-plate tectonics, and I have suggested that the Neoproterozoic might represent a period of transition during which vertical tectonism (diapirism and sagduction; “plume regime”?) and horizontal tectonism (“plate regime”) operated synchronously and potentially interactively (Lin, 2005; Parmenter et al., 2006). In support of the “evolutionary” view, I would like to offer the following comments, originally presented in a plenary discussion at Precambrian’95, held in Montreal in 1995.

Most, if not all, geologists agree that plate tectonics is a part of the earth system now. We should also agree that plate tectonics did not exist at the very early stages of Earth. (Before that, there was even no Earth!) If we agree on this, we should also agree that there must have been a period during the early stages of Earth’s evolution when the process of plate tectonics was conceived and “embryo” plate tectonics began. The embryo grew into a baby, the baby into a teenager, and the teenager into an adult: “modern-style” plate tectonics. The embryo and the baby might have looked, behaved, and functioned quite differently from the adult. Therefore, we cannot say plate tectonics did not exist in the Archean just because there is no blueschist in the Archean record or no komatiite in the Phanerozoic record.

So when did the life of plate tectonics begin? Some might say that it began the moment the embryo was conceived, while others would say that it did not begin until the baby was born. I suggest we had embryo and the baby plate tectonics in the Archean, and the answer to the question of when plate tectonics began will depend on how mature you believe the process had to be before it could be called “plate tectonics.”

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