

On the onset of plate tectonics in the very early Earth

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Plate tectonics is a particular mode of mantle convection in a planetary mantle, and so far it is observed only on Earth. Most of geological activities, such as earthquakes, volcanic eruption, and mountain building, occur when different plates interact at plate boundaries, and the realization that Earth's surface is actively deforming via plate tectonics was achieved through 1960s and 1970s, revolutionizing almost all branches of earth sciences. Plate tectonics is such an essential process, but we still do not understand the physics of plate tectonics in a satisfactory manner. The current situation may be paraphrased by the following three unresolved questions: (1) how did plate tectonics evolve in the past? (2) why does plate tectonics take place on Earth? and (3) when did plate tectonics first appear on Earth? Considerable progress has been made on the first question in the last decade, and this progress turns out to help better address the second and third questions as well. In this contribution, I will present a synthesis of the current status by combining theoretical considerations and a range of geological and geochemical observations, with a focus on the likelihood of initiating plate tectonics in the early Earth.