Tidal Rhythms Recorded in Precambrian Banded Iron Formations

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Banded iron formations (BIFs) are vividly banded marine deposits formed during the Precambrian. While relatively little is known about their formation processes, BIFs are considered to have been associated with periodic phenomena, such as seasonal cycles (varves). Detailed microscopic observations of BIF samples from Hamersley, Australia (ca. 2.5 billion years ago) were conducted to elucidate the cause of the cyclical patterns and the formation of BIFs. The observations revealed clastic layers of approximately 0.1 mm thick alternating with hematite layers of approximately 0.03-0.05 mm thick (sedimentation unit), with repetition of a distinct red layer of approximately 0.07-0.8 mm thick and a yellow layer containing abundant crocidolite (sedimentation cycle). The clastic layers contained minerals such as quartz and feldspar and had a graded bedding. Structures indicating liquefaction were also observed in the hematite and the yellow layers. The findings suggested that initial sedimentary structure before consolidation was preserved and that one event formed one sedimentation unit. The mean number of sedimentation units in a sedimentation cycle was 26.35, which is consistent with the value of 27.87 obtained for the number of spring-tide cycles estimated based on the rotation period of the earth and the orbit radius of the moon 2.5 billion years ago. Thus, since the sedimentation unit and the sedimentation cycles correspond with the ebb-and-flow of the tidal cycles and spring tides, respectively, the sedimentation rates associated with BIF development are considered to be markedly higher than was previously thought.

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