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Summer monsoon intensity as a recording mechanism of the astronomical rhythm in bedded chert

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The astronomical cyclicity recorded as sedimentary rhythms provide a clue to understanding the dynamics of Earth surface system. Bedded chert consists of rhythmical alternations of chert and shale beds whose rhythms are paced by astronomical cycles (Ikeda et al., 2010). However, the recording mechanisms of the sedimentary rhythms of bedded chert were still debated. To reveal their recording mechanisms, I attempted to extract paleoceanographic and paleoclimatologic information recorded in sedimentary rhythms of bedded chert on timescales of astronomical cycles based on the biogenic silica and terrigenous burial rates estimated for the bedded chert. To accomplish this objective, I conducted the major elements chemical analysis of individual chert and shale beds on the continuous sequence with bed-by-bed resolution. The biogenic silica and terrigenous contents were estimated, assuming the terrigenous material in the bedded chert as constant at the composition of the shale sample with the lowest SiO2 content among the samples analyzed, which is consistent with composition of the modern terrigenous material accumulated in the pelagic ocean. I calculated weights of biogenic silica and terrigenous material accumulated as a chert-shale couplet per unit area, which are well correlated with the chert bed thickness ($r = 0.96$) and shale bed thickness ($r = 0.90$), respectively. Based on these clear correlations, I regarded the chert bed thickness and shale bed thickness as approximate measures of biogenic silica and terrigenous burial rates, respectively, during one precession cycle, and reconstructed the variation in the biogenic silica and terrigenous burial rates during the Early Triassic to Early Jurassic for the bedded chert sequence in the Inuyama area. Together with paleogeographic distribution of bedded chert compiled from previous studies, the biogenic silica burial rate in the low latitude Panthalassa ocean in the form of bedded chert was a half to several times higher than the biogenic silica burial rate in the modern ocean (DeMaster, 2002). This result suggests that bedded chert was the major sink of dissolved silica in the ocean at least during the Early Triassic to Early Jurassic. Therefore, the variations in the biogenic silica burial rate in the bedded chert should be proportional to the variations in the dissolved silica input to the ocean, mainly through river input, in time-scales longer than the residence time of the dissolved silica in the ocean, 15 kyr (e.g. Treguer et al., 1995; Gaillardet et al., 1999). According to the geochemical modeling studies, the orbitally controlled summer monsoon intensity could have been a possible major controlling factor of the global silicate weathering intensity (Kutzubach, 1981). Therefore, variations in the orbitally-controlled summer monsoon intensity in Pangea should have had close association with variations in the biogenic silica burial rate in the form of bedded chert during the Early Triassic to Early Jurassic.

Keywords: chert, weathering, silica, Milankovitch, monsoon, eccentricity