[JJ] Evening Poster | B (Biogeosciences) | B-CG Complex & General

[B-CG10]Phanerozoic biodiversity change: Extinction and diversification

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Biotic evolution was the consequence of repeated extinction and following diversification in the past, which was caused by large-scale environmental changes, in particular, by extremely rapid and drastic forcing that changed the environments of the biosphere. Irreversible and episodic changes in material cycling on the planet and in galactic cosmic radiation are nominated as major driving mechanism for the alleged rapid, large-scale environmental perturbations. The biodiversity change in the fossiliferous Phanerozoic record is characterized by 5 major mass extinctions within the long-term trend of diversity increase. Nonetheless, each extinction event has been explained rather in ad hoc manner, without any universal explanation. This session discusses the Phanerozoic biodiversity change under a new light of the recent progress in geology.

[BCG10-P07]Quantitative estimation of continental weathering rate in the Ediacaran and Cambrian evidenced from radiogenic and stable Sr isotope ratios

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One of the most important biological evolution is the diversification of multi-cellular animals, and it occurred during the Ediacaran and the early Cambrian. Many researchers have a vague idea that life and Earth has co-evolved each other. The weathering influx from continents is thought to have a major influence on the change in seawater composition, and accordingly on biological evolution. The weathering influx can be estimated from the radiogenic Sr isotope ratio of carbonate rocks. The $^{87}Sr/^{86}Sr$ composition of seawater mainly depends on a mixing rate between non-radiogenic strontium derived from hydrothermal circulation occurring in oceanic crust and radiogenic input from continental weathering. Because of the large isotopic difference between them, the $^{87}Sr/^{86}Sr$ composition of seawater tracks the long-term changes in the continental weathering relative to the hydrothermal influx. Previous geochemical works indicated that some positive $^{87}Sr/^{86}Sr$ shifts are observed in Ediacaran and early Cambrian carbonate rocks. Increases of the $^{87}Sr/^{86}Sr$ ratios themselves, however, are induced by not only high weathering rate but also inactive hydrothermal circulation. Therefore, in view of stable Sr isotope ratios (δ$^{88/86}Sr$), I tried to quantitatively estimate the continental weathering rate in the Ediacaran and early Cambrian.

The stable Sr isotope composition of carbonate rock changes mainly depending on δ$^{88/86}Sr$ value of seawater and isotope fractionation during precipitation of carbonate minerals. Enhanced input of Sr reduces seawater δ$^{88/86}Sr$ value close to input value, and accumulation of Sr in seawater leads a large isotope fractionation. As a consequence, in the current oceanic environment, both processes results in low δ$^{88/86}Sr$ value of carbonate rock. In the fossiliferous succession in South China, four positive $^{87}Sr/^{86}Sr$ shifts are seen in carbonate rocks deposited during the Gaskiers glaciation, the Shuram excursion, the earliest Cambrian, and the late Terreneuvian (e.g., Sawaki et al., 2008, 2010). The interval of the earliest Cambrian exhibits the largest $^{87}Sr/^{86}Sr$ shift within them, but is not accompanied with low δ$^{88/86}Sr$ values. This suggests that the positive $^{87}Sr/^{86}Sr$ shift during the earliest Cambrian possibly resulted from inactive hydrothermal circulation at oceanic crust or reflected a local event. In contrast, intervals of the Shuram excursion and the late Terreneuvian show negative shifts in stable Sr isotope ratios together with positive

shifts in $^{87}Sr/^{86}Sr$ ratios. This suggests that continental weathering rates during these two periods were absolutely enhanced. The degrees of negative carbon isotope excursions of these two periods are greater than those of the other excursions in the studied section, which is likely attributed to the high continental weathering rates.