$^{10}Be/^{9}Be$ in FeMn crust 3514-6: a record of paleoceanographic changes

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Cosmogenic ^{10}Be, normalized to stable ^{9}Be, is used extensively for generating age models for ferromanganese (FeMn) crusts. This is based on the assumption that the input of both isotopes to the oceans has been relatively constant over the timescales of concern. ^{10}Be is derived from atmospheric production which precipitates directly to the oceans, while stable ^{9}Be is derived from continental weathering. While this assumption appears to hold true generally, the $^{10}Be/^{9}Be$ ratio recorded in an archive could deviate under special circumstances, such as for crusts deposited near marine gateways which had different configurations in the past compared with today. Changes in the origin of the water bathing a crust may cause changes to the recorded $^{10}Be/^{9}Be$ ratio that are completely unrelated to the decay of ^{10}Be, or changes to the inputs of either isotope.

The modern difference in the natural $^{10}Be/^{9}Be$ ratio of Mediterranean and Atlantic waters, $1.0x10^{-8}$ and $6.1x10^{-8}$ respectively[1], is resolveable and well-constrained. $^{10}Be/^{9}Be$ data for FeMn crust 3514-6, derived from high resolution subsampling of this crust, show clear and distinct discrepancies, generating reversals in apparent age. Crust 3514-6 was deposited on the Lion Seamount, approximately 900 km due west of the Strait of Gibraltar. This location is bathed by Mediterranean Outflow (MO), a water mass which is known to have deviated in terms of flow and plume height,[2] due to both gateway and climate changes. We interpret the discrepancies in the $^{10}Be/^{9}Be$ record as periods of time when MO did not bathe crust 3514-6. During the LGM, the MO plume is thought to have moved at greater depth; our data indicate that a similar deepening of flow may have occurred near the intensification of northern hemisphere glaciation ~3 Ma. Furthermore, gateway changes are recorded consistent with a blockage in the Gibraltar gateways prior to 5.33 Ma. Our findings demonstrate that, under special circumstances, the $^{10}Be/^{9}Be$ ratio records paleoceanographic information.

[1] von Blanckenburg et al. (2015) *Nat Geosci* 8, 538-542.
[2] Rogerson et al. (2012) *Clim Dynam* 39, 589–598.