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# Helium isotopes in ferromanganese crusts

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The He isotope systematics of ferromanganese crusts from the deep ocean floor can be explained by a mixture of extraterrestrial helium (implanted solar wind and galactic cosmic rays (GCR)) and terrestrial helium (radiogenic) from wind borne continental dust grains. $^{3}$He/$^{4}$He are typically in the range 10-20 $R_a$ similar to values measured in ferromanganese nodules However we have identified one crust, 237KD, from the Central Pacific Ocean that has extremely high $^{3}$He/$^{4}$He (up to 4440 $R_a$) that are comparable to the highest ratios measured in interplanetary dust particles (IDP) and micrometeorites (MM). The extremely high $^{3}$He concentrations, up to 8 x $10^{9}$atoms/g, cannot be explained by the presence of undegassed IDP, but requires that the extraterrestrial He is carried by occasional, high concentration GCR-He-bearing particles like MM. An excess of $^{60}$Fe in 237KD has been hailed as the first evidence of debris from a nearby supernova explosion. But $^{60}$Fe can also be produced from GCR reactions on Ni in extraterrestrial material. The maximum $^{3}$He/$^{60}$Fe of 237KD samples (100–800) is comparable to the ($^{3}$He/$^{60}$Fe)$_{GCR}$ (400-500) predicted for Ni-rich minerals that are common in iron meteorites. Consequently it is likely that the excess $^{60}$Fe originates from infalling MMs and is not derived from a supernova.

$^{3}$He and $^{4}$He concentrations, and $^{3}$He/$^{4}$He increase significantly from c 5 Ma. This is likely to be related to the increased trapping efficiency of infalling dense MM. We suggest that this is due to a decrease in the water current strength resulting from the closure of the Panama gateway. If change in $^{3}$He/$^{4}$He (and $^{3}$He) can be an efficient tracer of increase in MM flux, that maybe related to regional circulation variation, will be tested in other ferromanganese crusts.