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Terrestrial Alteration of Ordinary Chondrites from Antarctica

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Antarctica has been regarded as a Martian surface analog due to its freezing and hyperarid nature. Weathering processes under such extreme conditions may have contributed to the massive sulfate formations in the Martian regolith (e.g. [1]). 60% of meteorite finds on Earth were collected in the Antarctica blue ice fields. Although meteorites possess critical information of early solar system formation, terrestrial alteration could interfere with the pre-terrestrial signatures by redistributing elements and forming new minerals (e.g. oxidative weathering reactions). Meteorites can host secondary minerals (carbonates, sulfates and clays) that formed on their parent bodies and provide information about ancient aqueous processes. (e.g. [2]). Therefore discernment of terrestrial oxidative weathering signatures are critical to our study of the meteoritic material.

To better understand the mineralogical and isotopic fingerprints of Antarctic weathering, we examined sulfates from more than 30 individual ordinary chondrites (OC) of type 5/6, weathering category of B/C, from 9 ice fields, as well surface regolith from nearby nunataks. These OCs possess minimal parent body alteration and therefore all of the weathering present occurred in Antarctica. Although in trace quantity, Fe-sulfate is a common secondary phase often in proximity to sulfides and rust. Mg-, Ca-sulfates and jarosites were observed in few samples. $\delta^{34}S_{OC}$ values are significantly lower than regolith sulfates from Meyer Desert and Robert Massif. $\Delta^{33}S_{OC}$ values are largely consistent for troilites and sulfates, and are slightly lower than those of regolith. $\delta^{18}O_{OC}$ values overlap with those of regolith. Most interestingly, all examined OC sulfates possess pronounced positive $\Delta^{17}O_{OC}$ values. These isotope signatures imply that sulfates from OCs could be a mixture of two equal components: 1) dry or wet terrestrial atmospheric sulfate deposits; and 2) oxidized troilite. We suggest that caution should be taken when interpreting isotope signatures of secondary minerals from meteorite finds, such as those of Martian sulfates [3] that have exhibited isotopic compositions that fall well within our reported range.

[1]Burns and Fisher (1993), Journal of Geophysical Research 98, 3365-3372

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[3]Farquhar and Thiemens (2000), Journal of Geophysical