Surface alteration of Fe-Ni meteorites analyzed by the Opportunity Mars Exploration Rover

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Between July and October, 2009, the Mars Exploration Rover Opportunity visited three cobble-sized Fe-Ni meteorites named 'Block Island', 'Shelter Island', and 'Mackinac Island' that were similar to the 'Heat Shield Rock' meteorite studied in January, 2005. Visible/near-infrared (432-1009nm) images acquired by the Panoramic Camera (Pancam) suggested ferric-rich nanophase (np) dust contaminated the rock surfaces, as well as patches of smooth materials with 'purple' hues in Pancam false-color images. These materials occurred in topographically low areas and exhibited lobate margins in Microscopic Imager images that appeared to coat the underlying meteorite surface. They exhibited negative near-infrared slopes (753nm-934nm), lack of a 860nm band (usually present in crystalline hematite) and greater 535nm band depths than typical meteorite surfaces. As such, these spectra are consistent with a mixture of ferric materials, dominated by np-hematite. This is consistent with Mössbauer data of these coatings that suggest minor phases of ferric oxide such as np-hematite in addition to kamacite. APXS data show enrichments in Mg, Br, and Zn relative to the rest of the meteorite surface. These analyses suggest that the 'purple' coatings are altered or secondary weathering materials, perhaps formed when the meteorites were previously buried, but then subsequently exposed and partially eroded by aeolian abrasion.

Testing climatic controls on speleothem dead carbon fraction in a Holocene stalagmite: Implications for speleothem-based radiocarbon calibration

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To determine the precise timing and nature of past climate changes, paleoclimate archives must have a precise and accurate chronology, yet uncertainty in the radiocarbon calibration curve during the deglaciation and last glacial period limits our understanding of the timing and mechanisms of climate changes during this period. Speleothems, which can be precisely dated with U-Th methods, hold great potential for improving the ^{14}C calibration, but may be complicated by changes in the dead carbon fraction (DCF) derived from bedrock. To test for climatic controls on speleothem DCF, we present new ^{14}C data from a 2.5 m long, annually banded stalagmite, HS-4, collected from Heshang Cave, China (30°27′N, 110°25′E), the site of extensive modern calibration and paleoclimate reconstruction efforts.

HS-4 formed continuously over the previous 9.5 kyr and has been precisely dated with 21 U-Th dates [1]. Radiocarbon measurements on 50 samples collected from the HS-4 growth axis, combined with the published U-Th age model allow us to calculate Holocene DCF variations following Genty *et al*. [2]. To determine the sensitivity of DCF to rainfall variations, we compare the DCF record with the HS-4 $\delta^{18}O$ record [1], which indicates significantly increased rainfall in the early and middle Holocene.

[1] Hu *et al*. (2008) *Earth Plan. Sci. Lett.* **266**, 221–232. [2] Genty *et al*. (2001) *Geochim Cosmochim Ac*. **65**, 3443–3457.