TWO UNBRECCIATED, VESICULAR, POSSIBLY PAIRED EUCRITES, BOTH TOTALLY UNMETAMORPHOSED AND EXTRAORDINARILY SODIUM-RICH: NORTHWEST AFRICA 7035 AND NORTHWEST AFRICA 8661.

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Only a small minority of the more than one thousand known eucrites are unbrecciated [1]. Only a tiny minority (now perhaps 5?) are conspicuously vesicular [2]. The proportion that have escaped even mild thermal metamorphism is not much bigger than that. It is also rare, especially among the majority noncumulate type of eucrites, to encounter deviation from a narrow range of composition-space. In this work I characterize two Northwest Africa eucrites, NWA 7035 and NWA 8661, that display similar exceptionalism in all of these ways. Despite a mild disparity in measured oxygen-isotopic compositions (reported in their *Met. Bull.* entries), I suspect these two may be paired.

Both NWA 7035 and NWA 8661 are mildly, but among eucrites very exceptionally, vesicular, with the vesicles typically irregular-elongate (seldom round) in shape, and mostly associated with mesostasis. Vesicles constitute about 3.5 vol% of NWA 7035 and 3.7 vol% of NWA 8661. The nearest precedent is Ibitira, a highly metamorphosed and generally odd [3] (non-Vestan?) eucrite with about 3 vol% preponderantly near-spherical vesicles [2]. A considerable portion of the vesicularity in both of the subject eucrites occurs as small cavities within plagioclase. It has been inferred from the expectation of extremely feeble pressure in surface flows on any asteroid that the rare vesicular eucrites must have originally crystallized several km deep in the crust [2]. If so they would be unlikely to fully avoid thermal metamorphism [cf. 1]. However, the vesicles in NWA 7035 and NWA 8661 may have formed late enough in a near-surface igneous crystallization process to become trapped.

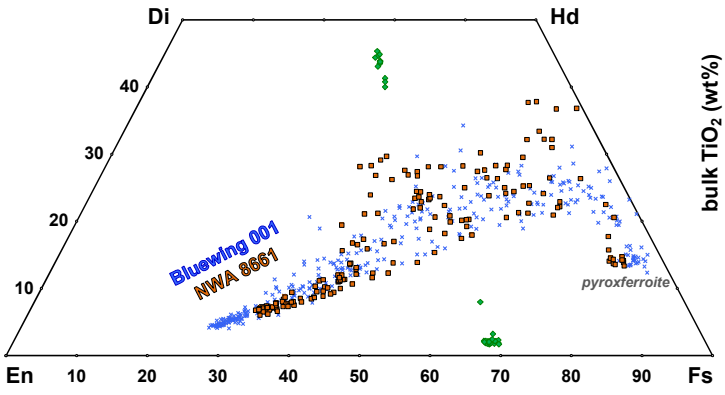

Fig. 1. Pyroxene compositions of two unmodified-igneous eucrites, and for comparison one typically metamorphosed eucrite. Data from NWA 7035, not shown, are virtually identical to NWA 8661.

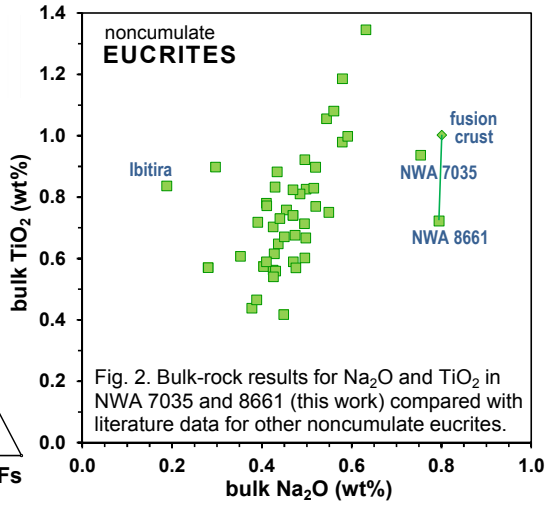

Fig. 2. Bulk-rock results for Na_2O and TiO_2 in NWA 7035 and 8661 (this work) compared with literature data for other noncumulate eucrites.

The total avoidance of thermal metamorphism in both NWA 7035 and NWA 8661 is manifested, inter alia, by exquisite preservation of minute-scale igneous textures, and by extensive zonation within the pyroxenes (Fig. 1) along a trend that begins in both cases at precisely the same, distinctively ferroan (in this context), composition. Textural similarity between the two extends to mildly ophitic enclosure of many of the smaller plagioclase grains within some of the larger pyroxenes. As noted by [4], this texture, too, is rare among eucrites. Also, both feature distinctive late-igneous veins of evolved (high Na, low Mg) composition scattered within cores of some pyroxenes.

Both NWA 7035 and NWA 8661 are also distinctly enriched in sodium compared to other noncumulate eucrites (Fig. 2). The data for NWA 8661 are from both microprobe fused-bead analysis (MFBA) and INAA [cf. 5]; backed up by microprobe data for a small region of the fusion crust. Data for NWA 7035 are as-yet only from MFBA, but from long experience we know that MFBA and INAA are both highly accurate for sodium in eucrites. The degree to which the sodium-rich composition is related to the distinctive textural and low-metamorphism characteristics of this duo will become clearer as more and more eucrites are characterized in coming years.

References: [1] Mayne R. G. et al. (2009) *Geochim. Cosmoch. Acta* 73, 794-819. [2] McCoy T. J. et al. (2006) *Earth Planet. Sci. Lett.* 246, 102-108. [3] Mittlefehldt D. W. (2005) *Meteor. Planet. Sci.* 40, 665-677. [4] Irving A. and Kuehner S. (2012) *Met. Bull.* entry for NWA 7035. [5] Warren P. H. et al. (2009) *Geochim. Cosmoch. Acta* 73, 5918-5943.