

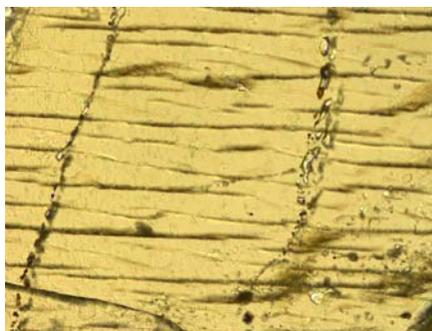
NORTHWEST AFRICA 6704: A UNIQUE CUMULATE PERMAFIC ACHONDRITE CONTAINING SODIC FELDSPAR, AWARUITE AND “FLUID” INCLUSIONS, WITH AN OXYGEN ISOTOPIC COMPOSITION IN THE ACAPULCOITE-LODRANITE FIELD.

A. J. Irving¹, R. Tanaka², A. Steele³, S. M. Kuehner¹, T. E. Bunch⁴, J. H. Wittke⁴ and G. M. Hupé. ¹Dept. of Earth & Space Sciences, University of Washington, Seattle, WA 98195, irving@ess.washington.edu; ²Institute for Study of Earth's Interior, Okayama University, Misasa, Japan; ³Geophysical Laboratory, Carnegie Institution, Washington, DC; ⁴Geology Program, SESES, Northern Arizona University, Flagstaff, AZ.

Petrography: A very fresh, dense, yellowish-green stone with rounded, shiny exterior surfaces and small patches of remnant black fusion crust found in Algeria is a unique, medium grained (gs 0.3-1.5 mm), unshocked achondrite with an igneous cumulate texture. Smaller grains of olivine (Fa_{51.6-53.2}; FeO/MnO = 120-140; NiO = 0.9-1.0 wt.%) and chromite [Cr/(Cr+Al) = 89.0] are enclosed within large (up to 1.5 mm) orthopyroxene oikocrysts (Fs_{41.6-42.4}Wo_{2.8-3.6}, FeO/MnO = 81-106), which are surrounded by intercumulus indistinctly-twinned, very sodic plagioclase (Ab₉₂An₄Or₄) and tiny grains of awaruite (Ni = 75 wt.%). Orthopyroxene grains contain curvilinear trains of tiny rounded to irregularly-shaped, clear to pinkish inclusions (<2-30 μm), which appear on polished surfaces to be empty bubbles with smooth rounded walls. Confocal Raman spectroscopy of inclusions below thin section surfaces did not reveal any fluid species.

Oxygen Isotopes: Replicate analyses of acid-washed bulk material by laser fluorination gave: δ¹⁷O 1.015, 0.880; δ¹⁸O 3.922, 3.613; Δ¹⁷O -1.048, -1.020 per mil, respectively. These results plot in the field for acapulcoites and lodranites [1].

Discussion: This specimen is unlike any other known achondrite in its combined mineralogical features: mafic silicate minerals with elevated FeO/MnO ratios, extremely sodic plagioclase, trapped bubble trains and very Ni-rich metal. Despite its oxygen isotopic composition, NWA 6704 bears no mineralogical resemblance to members of the acapulcoite-lodranite clan. It appears to be a cumulate igneous rock related to an unknown “planetary” parent body, which evidently was capable of interior melting and crystal accumulation. The relatively ferroan silicates, very sodic plagioclase and now empty (?) fluid inclusions (see below) suggest a somewhat “Earth-like”, differentiated parent body.



Bubble trains and cleavages in orthopyroxene; WOF 0.6 mm

References: [1] Clayton R. and Mayeda T. (1996) *Geochim. Cosmochim. Acta* **60**, 1999-2017; Irving A. et al. (2007) *Lunar Planet. Sci.* **XXXVIII**, #1338.