GAMMA IRRADIATION EFFECTS IN MARS ANALOGUES. A.W.Needham[1], C.L. Smith[1], K.T. Howard[1], G.K.Benedix[1], M.A.Sephton[2], Z.Martins[2], N.J. Foster[3], I.A.Franchi[4], S.S.Russell[1], [1]IARC, Department of Mineralogy, The Natural History Museum, London, SW7 5BD, UK (A.W.Needham@open.ac.uk). [2]IARC, Department of Earth Science and Engineering, Imperial College, London, UK. [3]Centre for Astrophysics and Planetary Sciences, School of Physical Sciences, Ingram Building, University of Kent, Canterbury, Kent, CT2 7NH, UK.[4]PSSRI, The Open University, Milton Keynes, MK7 6AA, UK

Introduction: The search for life on Mars is a primary focus of sample return missions planned for the coming decades. Although the chance of finding extant life in returned samples is small, it is non-zero, and suitable precautions must be taken. Mars sample return (MSR) missions will be designated COSPAR category IV_{b-c}[1], and sterilisation of Martian material will be essential prior to removing samples from biocontainment. Previous studies indicate that gamma irradiation with doses exceeding 30 Mrad may provide a suitable method of biological sterilisation due to the limited alteration it produces in the host sample [2,3]. The present study provides further information regarding gamma irradiation effects on petrological, chemical, isotopic, and organic properties in a range of Martian analogue material.

Methods: A ^{60}Co radiation source was used to expose the samples to ≥30Mrad. A broad range of analytical techniques have been employed to analyse irradiated and unirradiated samples; these include electron, optical and IR microscopy, XRD, Raman spectroscopy, ICP-MS, light stable isotope analyses (C, N, O), and analyses of organic compounds.

Results: The effects of gamma irradiation on mineralogical, chemical and isotopic properties are limited. XRD results demonstrate that gamma irradiation has no obvious systematic effects on crystal structure. Optical properties of most minerals are unaffected, though halite is a significant exception, as discussed in detail by [2]. Preliminary electron microscopy investigation (secondary electron imaging) revealed no significant surface alteration effects. The finest-scale features are under investigation by Field Emission SEM (and TEM where appropriate). Detailed results from major and trace element, stable isotope, organic, and Raman spectroscopy analyses will also be presented at the conference.

Implications: Samples returned from Mars may require sterilisation prior to removal from biocontainment and distribution to the scientific community, at least in the case of the initial sample aliquots released. The results of this study continue to support gamma irradiation as a preferred sterilisation technique. In comparison with chemical or UV techniques (which only sterilise surface materials), or dry heating (which causes significantly more damage to key scientific records), gamma irradiation represents an excellent combination of effective sterilisation and sample preservation.

References: [1] Rummel et al. (2002), *Report of the COSPAR/IAU Workshop on Planetary Protection* [2] C.C.Allen et al. (1999) *Journal of geophysical research, vol. 104* [3] A.W.Needham et al. (2008) *Meteoritics & Planet. Sci., 43, A5279*