

# Open Research Online

---

The Open University's repository of research publications and other research outputs

## Ar-Ar age and halogen characteristics of nakhlite MIL 03346: records of crustal processes on Mars

Conference or Workshop Item

How to cite:

Anand, M.; Burgess, R.; Fernandes, V. and Grady, M. M. (2006). Ar-Ar age and halogen characteristics of nakhlite MIL 03346: records of crustal processes on Mars. In: 69th Annual Meeting of the Meteoritical Society, 6-11 Aug 2006, Zurich, Switzerland.

For guidance on citations see [FAQs](#).

© [not recorded]

Version: [not recorded]

Link(s) to article on publisher's website:

<http://www.lpi.usra.edu/meetings/metsoc2006/pdf/5257.pdf>

---

Copyright and Moral Rights for the articles on this site are retained by the individual authors and/or other copyright owners. For more information on Open Research Online's data [policy](#) on reuse of materials please consult the policies page.

---

[oro.open.ac.uk](http://oro.open.ac.uk)

## AR-AR AGE AND HALOGEN CHARACTERISTICS OF NAKHLITE MIL 03346: RECORDS OF CRUSTAL PROCESSES ON MARS

M. Anand<sup>1,2</sup>, R. Burgess<sup>3</sup>, V. Fernandes<sup>4</sup> and M.M. Grady<sup>1</sup>  
<sup>1</sup>Centre for Earth, Planetary, Space and Astronomical Research (CEPSAR), The Open University, Milton Keynes, UK. E-mail: M.Anand@open.ac.uk <sup>2</sup>Department of Mineralogy, The Natural History Museum, London, UK. <sup>3</sup>Department of Earth Sciences, University of Manchester, Manchester, UK. <sup>4</sup>Instituto Geofísico, Universidade de Coimbra, Portugal

**Introduction:** MIL 03346 is one of the 7 members of the nakhlite group of Martian meteorites. The texture and mineralogy of this rock distinguishes it from other nakhlites [1]. Almost complete absence of crystalline plagioclase and ferrohedenbergitic rim on pyroxene phenocrysts are some of the unique characteristics of this sample. Previous Ar-Ar age study of MIL 03346 reported a total Ar-Ar age of 1.37 Ga [2]. Recent reports have also highlighted presence of exotic minerals such as K-Cl-rich amphibole in melt inclusions in pyroxenes and olivines in MIL 03346 [3]. The non-chondritic halogen ratios in nakhlites have been interpreted as a result of fluid activity on Mars [4]. In the present study we have combined measurements of step-heating Ar-Ar ages with that of halogen contents. The work was conducted on ~12 mg whole-rock sample, sliced out from 1g allocation of MIL 03346,37 from the MWG to the senior author.

**Results:** The total Ar-Ar age is  $1360 \pm 2$  Ma, similar to that reported by [2]. The main release of K is between 600-900 °C and there is a clear decrease in age with temperature, most likely recoil-related. The major Cl release occurs at around 1000 °C, is therefore separate from K release, and accompanies the release of Ca from pyroxene. The measured halogen contents in MIL 03346 are high relative to other SNC meteorites, only lower than Nakhla [4]. The halogen data for MIL 03346 are: Cl = 156 ppm; Br = 0.41 ppm; I = 0.014 ppm. The halogen ratios of Nakhla are slightly higher than MIL (Br/Cl = 0.002; I/Cl =  $6 \times 10^{-5}$ ) but this may be explained by high Br/Cl and I/Cl ratios of martian weathering components in alteration veins in Nakhla olivines [5]. For comparison the martian regolith Br/Cl = 0.007 and I/Cl =  $16 \times 10^{-5}$  [6] while shergottites are more similar at Br/Cl = 0.005; I/Cl =  $3 \times 10^{-5}$ .

The presence of K-Cl-rich amphibole in melt inclusions in pyroxene could explain the major Cl release at high temperature and some of the recoil effect if  $^{39}\text{Ar}_K$  moves from the melt inclusions into the pyroxene. Alternatively,  $^{39}\text{Ar}_K$  may also be released from the mesostasis glass but then we would also expect to see major Cl release at the same time. Between 600-850 °C 73% of total K and 26% of total Cl are released; >900 °C the values are 21% and 67%; so the majority of halogen release presumably comes from the melt inclusions. This indicates that the Br/Cl and I/Cl are representative of the melt (although they may originate from a soil contaminated melt).

**References:** [1] Anand M. et al., 2005. 36<sup>th</sup> Lunar and Planetary Science Conference. Abs # 1639. [2] Bogard, D.D. and Garrison, D.H. 2006. 37<sup>th</sup> Lunar and Planetary Science Conference. Abs # 1108. [3] Sautter V. et al. 2006. 37<sup>th</sup> Lunar and Planetary Science Conference. Abs# 1318. [4] Dreibus et al. 2006. 37<sup>th</sup> Lunar and Planetary Science Conference. Abs# 1180. [5] Sutton S.R. et al. 2002. 33<sup>rd</sup> Lunar and Planetary Science Conference. Abs # 1278. [6] Rao M.N. et al. 2002. *Icarus* 156, pp. 352-372.