RADIOGENIC 129-XENON IN SILICATE INCLUSIONS IN THE CAMPO DEL CIELO IRON METEORITE. A. Meshik[1] , G. Kurat[2], O. Pravdivtseva[1], and C. M. Hohenberg[1], [1]McDonnell Center for the Space Sciences and Physics Department of Washington University, One Brookings Drive, Saint Louis, MO 63130, USA (am@wustl.edu), [2]Naturhistorisches Museum, Postfach 417, A-1014, Vienna, Austria (gero.kurat@univie.ac.at).

Iron meteorites present a challenge for the I-Xe dating technique because it is usually the inclusions, not metal, that contain radiogenic xenon and iodine. Silicate inclusions are frequent in only types IAB and IIE, and earlier studies of irons have demonstrated that I-Xe system can survive intact in these inclusions preserving valuable age information [1–5]. Our previous studies of the I-Xe record in pyroxene grains from Toluca iron suggested an intriguing relationship between apparent I-Xe ages and (Mg+Fe)/Fe ratios [6]. The I-Xe system in K-feldspar inclusions from Colomera (IIE) had the fingerprint of slow cooling, with an indicated cooling rate of 2-4 °C/Ma [7]. Here we present studies of the iodine-xenon system in a silicate-graphite-metal (SiGrMet) inclusion of the IA Campo del Cielo iron meteorite from the collection of the Museum of Natural History in Vienna.

An early study of noble gases from Campo del Cielo (the El Taco mass [8]) was conducted on separated silicate inclusions, which were crushed, sieved and chemically treated. That work [8] demonstrated that silicate inclusions indeed contain excesses of ^{129}Xe, although the carrier phase remained unknown.

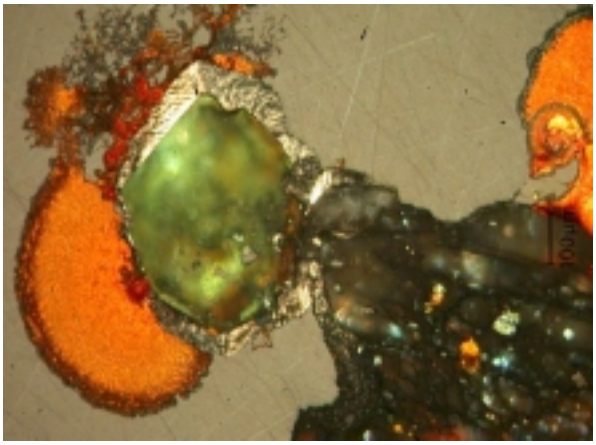

Figure 1. Diopside (green), albite (black), graphite (silver), metal (tan) and rust (orange) in SiGrMet inclusion from Campo del Cielo.

From a large (~10 cm) round SiGrMet inclusion from Campo del Cielo, which consists mainly of granular metal with variable amounts of silicates dispersed throughout, we prepared a polished section for mineral identification and in-situ Xe anaylsis. This specimen contains abundant millimeter-sized diopside and albite, both commonly enveloped by graphite. Cl-bearing rust grows quickly in the laboratory, primarily at grain boundaries (Fig.1). The minerals were identified by optical and analytical electron microscopy utilizing a JEOL-840A scanning microscope.

The polished thin section of silicate inclusions from Campo del Cielo used in this study unfortunately was embedded in epoxy, which usually cannot be exposed to the clean high vacuum of the extraction system. To reduce heavy hydrocarbon contamination, the section was placed in the laser extraction cell which was maintained at 110°C for almost three months under continuous pumping by an off-line pumping station. When the residual pressure at this temperature reached 10^{-9} Torr, the whole extraction cell was disconnected from the pumping station and attached to the mass spectrometer without exposing the sample to air. The cell was then further degassed at 100°C under continuous cleaning by an ion pump. However, in spite of this extended degassing, the pressure and the Xe blank built up quickly under closed cell conditions. Therefore all possible efforts were made to minimize the insulation time of the cell. After rastering of a 300×300 μm area, which takes about 40 seconds, the cell was opened to the sample system for another 50 seconds, transferring the gas, and then closed for cleanup of this gas. This procedure allowed us to reach a ^{132}Xe blank of less than 5×10^{-15} cm^3 STP, while losing only about 5% of the extracted Xe. The laser extraction itself was conducted with acoustically Q-switched Nd-YAG laser (1064 nm) using an average power of 25W (25μm spot size). Released gases were exposed sequently to the getter alloy SAES St707 pellets (maintained at 275°C) and then to a freshly deposited Ti-film (flash getter). Heavy noble gases were separated from He, Ne and Ar using activated charcoal at a temperature of –90°C for adsorption of the Xe (the light gases pumped away) and +265°C for desorption. The isotopic composition of the released Xe was measured by high transmission ion-counting mass-spectrometry [9]. Eight different 300×300μm excavations were done, each approximately 12 μm deep. Typical raster areas are shown in Fig. 2, numbers in Table 1.

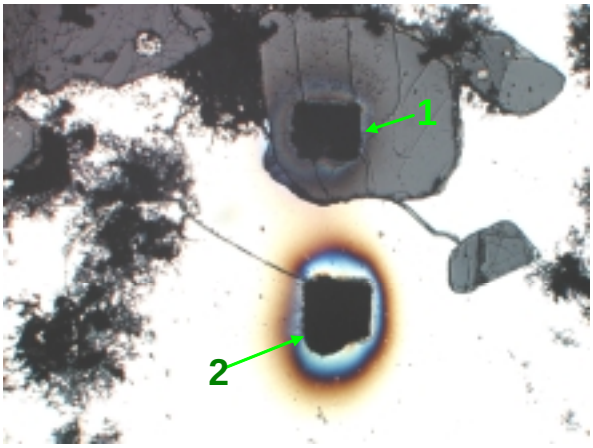

Fig. 2. Excavated 300×300 μm areas of Campo del Cielo iron. 1 – diopside, 2 – metal. Rust lace is visible at the left.

Table 1. Concentation of radiogenic ^{129}I in various grains from SiGrMet inclusion of Campo del Cielo.

Rastered mineral	$^{129}Xe^{*} \times 10^{-7} cm^2/g$
Diopside (ge#1)	4.5
Diopside (ge#3)	5.4
Albite without Fe (ge#6)	0.9
Albite with Fe (ge#8)	5.6
Olivine (ge#4)	< 0.01
Rusty spot (ge#2)	< 0.02
Metal (ge#7)	< 0.04
Metal (ge#5)	< 0.03

As expected no radiogenic ^{129}Xe was found in the metal itself, nor was it found in the rust or in olivine. But both diopside and albite show clear excesses of radiogenic ^{129}Xe, in fact, the released Xe is almost monoisotopic ^{129}Xe with no measurable trapped Xe (Fig. 3). There is no detectable fission Xe in either mineral.

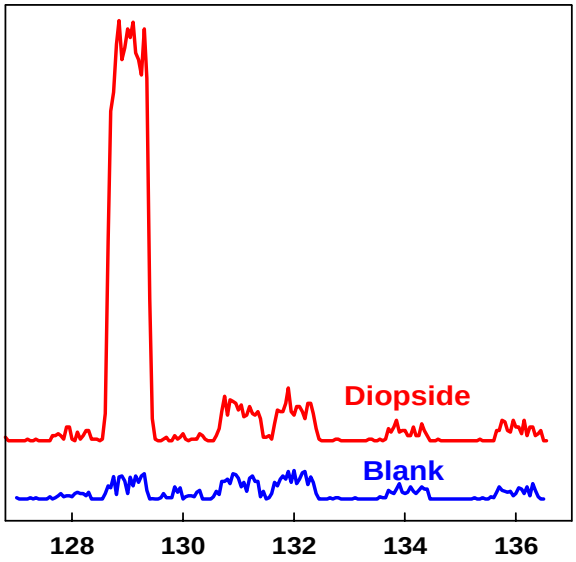

Fig. 3. Xe mass spectra of diopside (ge#1), and the corresponding blank, showing a spectrum that is essentially monoisotopic ^{129}Xe.

These results show diopside and albite from the Campo del Cielo iron are promising candidates for I-Xe dating and we are presently preparing separated crystals for irradiation. The virtual absence of trapped Xe in all of the minerals studied here, and the observation of trapped Xe concentrations similar to chondritic in previous studies [8] suggests that the trapped gases may be concentrated in the thick graphite rims (similar to what was found in Magura [10]), perhaps acquired by a mechanism similar to active capture [11]. To check this possibility we are in the process of studying Xe in rims.

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References: [1] Alexander E. C., Jr and Manuel O. K. (1968) *EPSL* 4, 113–117. [2] Bogard D. D. et al. (1971) *GCA 35*, 1231–1254. [3] Alexander E. C. Jr. et al. (1969) *EPSL* 6, 355–358. [4] Alexander E. C. Jr. et al. (1970) *EPSL* 8, 188. [5] Podosek F. A. (1970) *GCA* 34, 341–365. [6] Pravdivtseva O. V. et al. (1998) *LPSC XXIX* Abstract #1818. [7] Pravdivtseva O. V. et al. (2000) *LPSC XXXI*, Abstract #1929. [8] Hintenberger H. et al. (1968) in *Meteorite Research*, 895–900. [9] Hohenberg C. M. *Rev. Sci. Insr.*51, 1075–1082. [10] Maruoka T, *MAPS*, in press. [11] Hohenberg C. M. et al. (2002) *MAPS* 37, 257–267.