ESRF	Investigation of solid Xe-SiO2 compounds relevant for the Earth at high pressure and high temperature.	**Experiment number:** HS1887
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Report:

The search for a hidden reservoir of xenon in the Earth is a long standing issue since it was noticed that the atmospheres of the Earth and Mars are depleted in xenon by a factor of 20 relative to other rare gases (i.e., Ne, Ar and Kr) [1]. More recently, the quantity of "missing Xe" as refined up to 90% of the Earth primordial Xe [2]. These geochemical observations could be explained if the normally inert Xe becomes increasingly soluble or can even form compounds under the conditions found within planetary interiors, thus resulting in depletion of Xe in the atmosphere. The stability of xenon-silica phases at deep crustal conditions has been evidenced by Raman spectroscopy [3].

We used a large volume apparatus (Paris-Edinburgh press) which allowed access to the $P-T$ range of 0.5-5 GPa and 300-2500 K, while monochromatic x-ray diffraction data were collected *in situ*. The challenge in these experiments was to get x-ray data on large volume samples of gases. Xenon had to be confined in a sealed and inert capsule, usually made of heavily x-ray absorbant material such as platinum, rhenium or gold. To overcome this problem, the monochromatic x-ray beam was tuned to high energy, $E = 78.1$ keV, since the absorption coefficient, μ, for a given element increases with atomic mass and wavelength. However, the photon flux delivered by the synchrotron ring decreases with the x-ray beam energy, a high brilliance source was therefore necessary for the diffracted x-ray beam to be of sufficient quality for analysis.

In situ x-ray diffraction data show that when a xenon-silica mixture is brought to high pressure and temperature, quartz is stabilized outside of its stability field in both pressure and temperature up to 5 GPa and 2000 K. Besides, liquid xenon could not be observed, attesting its dissolution in quartz. These results indicate that the chemical affinity of Xe and silica increases at high pressures and temperatures. The nature of Xe-SiO_2 bonding needs to be resolved by in sity EXAFS studies in the future.

References:

1 E. Anders and T. Owen, Science, *198*, 453, 1977.
2 M. Ozima and F. A. Podosek, J. Geophys. Res., *104*, 25493, 1999.
3 C. Sanloup et al., Geophys. Res. Lett.,*29*, 30-1, 2002.