The effects of irradiation on the noble gases in matrix material of the Allende (CV3) meteorite

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Background

Micro-computed X-ray tomography (µ-CT) :

- ✓ Fast technology for studying textural, physical, and chemical properties of solid samples in 3 dimensions
- ✓ Currently becoming very popular in planetary sciences → sample preparation, curation, …

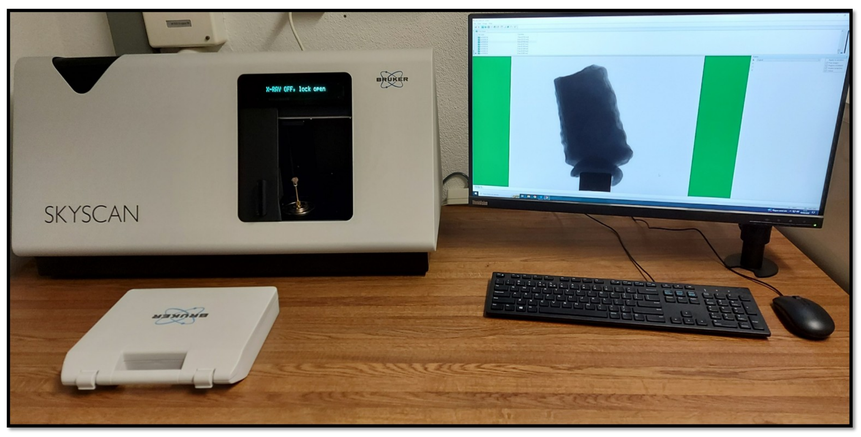


Fig 1. µXCT-Scanner (Bruker SkyScan 1174) at University of Bern

Experimental (1)

- o Here we study if X-ray scanning affects the noble gas budget of matrix samples from the CV3 chondrite Allende
- o We separated → Matrix material; Chondrules; CAIs (Calcium-Aluminum-rich Inclusions)
- o Matrix material → further powdered → sieved (33-µm mesh)
- o Why such a small grain size? If there are no measurable effects for such small grain sizes, there are no effects for bigger objects (that we usually study)
- o powdered matrix samples → irradiating three samples using the µXCT-Scanner (Bruker SkyScan 1174)
- o Irradiation energies → **30 keV, 50 keV, 70 keV** **(plus two non-irradiated samples)**

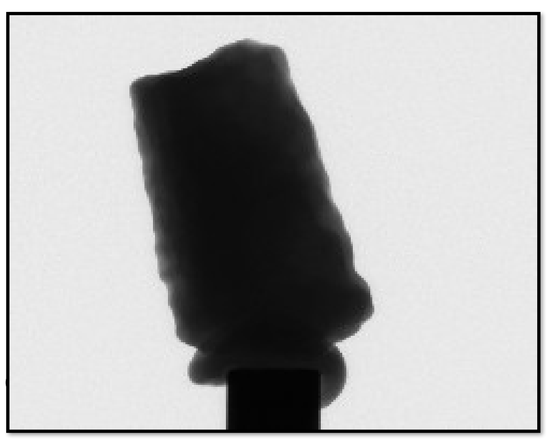


Fig 2. Image of sample scan

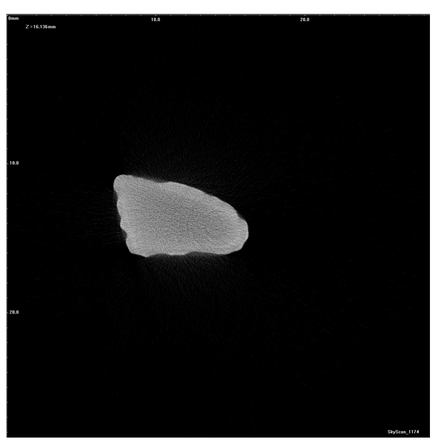
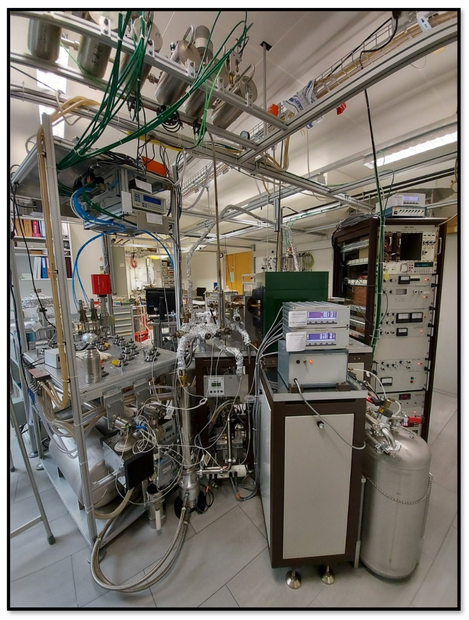


Fig 3. Cross section of sample in µXCT

Experimental (2)

- o Five matrix samples from Allende meteorite. Three irradiated in µXCT, two non-irradiated samples
- o Samples preheated in vacuum (approx. at 150°C, 24 h)
- o Sample degassing by laser melting ~2500°C
- o Measure He and Ne isotope concentrations using static noble gas mass spectrometry (MAP 215-50)



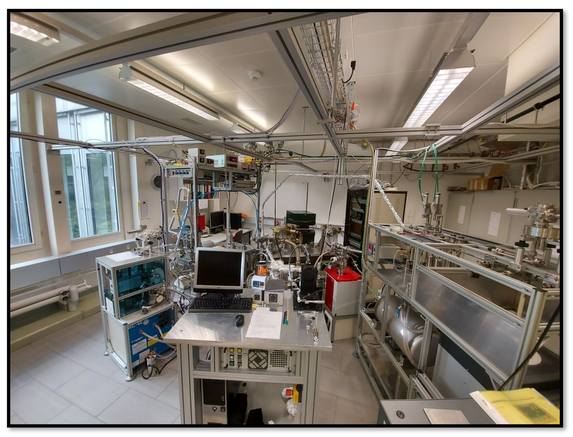


Fig 4. Noble gas laboratory at the University of Bern

Results & Conclusion

- o $^{3}He/^{21}Ne$ averages → non-irradiated → 0.945 ± 0.020; irradiated samples → 0.950 ± 0.021
- o No significant differences in the noble gas budgets between irradiated and non-irradiated samples, no trend with radiation dose

Sample	$^{3}He/^{21}Ne$	Uncertainties	$^{3}He/^{4}He$	Uncertainties
1	0.964	0.005	117006	727
2	0.925	0.010	113494	1471
3	0.953	0.004	114923	778
4	0.974	0.006	115773	888
5	0.922	0.007	111104	894

(ratios are in arbitrary units, not corrected for detector sensitivity)

Sample	Weight [mg]	Irradiation energy [kV]	Source current [microA]	Irradiation time [hours]	Radiation Dose (Gy)
1	2.66	no irradiation	-	-	-
2	2.82	no irradiation	-	-	-
3	2.57	100	100	13	152
4	2.57	70	142	14	114
5	2.49	30	210	14	31

References

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