THE MSFC NOBLE GAS RESEARCH LABORATORY (MNGRL): A NASA INVESTIGATOR FACILITY

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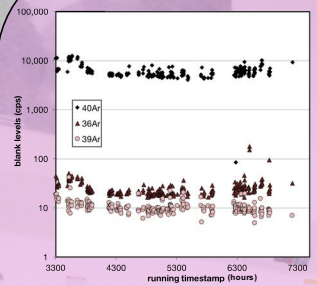
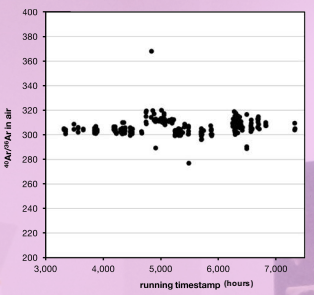
MNGRL
The MSFC Noble Gas Research Laboratory

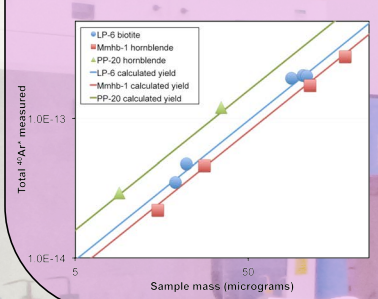
Noble-gas isotopes are a well-established technique for providing detailed temperature-time histories of rocks and meteorites. We have established the MSFC Noble Gas Research Laboratory (MNGRL) at Marshall Space Flight Center to serve as a NASA investigator facility in the wake of the closure of the JSC laboratory formerly run by Don Bogard. The MNGRL lab was constructed to be able to measure all the noble gases, particularly Ar-Ar and I-Xe radioactive dating to find the formation age of rocks and meteorites, and Ar/Kr/Ne cosmic-ray exposure ages to understand when the meteorites were launched from their parent planets.

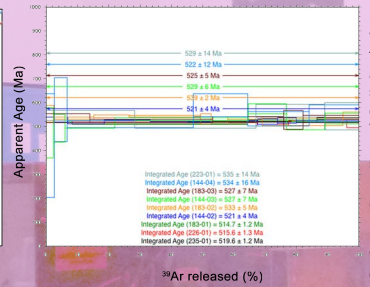
Calibration and Characterization





MNGRL combined extraction line and mass spectrometer blanks (procedural background measurement) are ^{40}Ar = 8.08E-16 mol (±22%); ^{39}Ar = 4.15E-18 mol; ^{36}Ar = 1.15E-17 mol. Air analyses yield a reproducible terrestrial atmospheric ratio of $^{40}Ar/^{36}Ar$ = 291.90 ± 0.06%. The baseline (off-peak) measurements on our air pipettes typically show 0-1 counts (after blank correction).

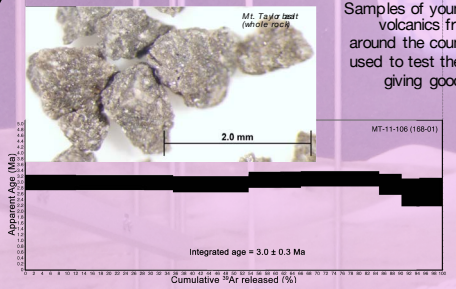


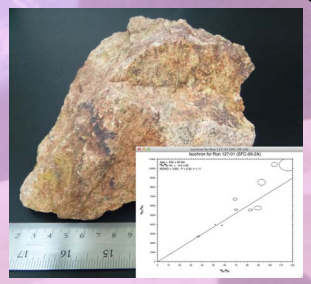


Unirradiated standards were used to calibrate the laser heating system and determine the sensitivity of our detectors and sample yield. MNGRL irradiation packages contain the standards Mmhb-1 hornblende, LP-6 biotite, and PP-20 hornblende. Multiple splits of Mmhb-1 yield ages consistent with the reference age of 523.1 ± 1.6 Ma.

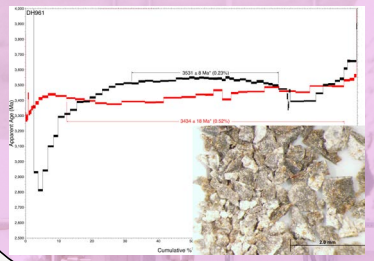
Sample Results

Samples of young (3 Ma) volcanics from areas around the country were used to test the system, giving good results.





Older (1 Ga), K-rich plagioclase samples from the Santa Fe Crater granite body show regional exhumation of the area in the Proterozoic, which is the same age observed in previous analyses of this sample.



Lunar meteorite Dhofar 961 exhibits an apparent age of ~3.5 Ga, along with diffusive gas loss in the low-temperature steps, and recoil effects in the high-temperature steps. Our sensitivity and precise temperature control increases confidence in derived ages, reveals irregularities in gas release, and enables diffusion parameters to be recovered and multi-domain behavior to be investigated (see poster #1389 in this session for moe details!)

- Photon Machines FUSIONS.970 laser heating system with confocal optics and two-color infrared pyrometer
- Laser hovers over two sample ports with quartz windows and has fully automated positioning and power
- Samples enclosed in Pt/Ir tube achieves uniform heating to enable precise thermal control for thermochronometry and diffusion studies
- Irradiation at the Oregon State University's TRIGA facility in the cadmium-lined core position (CLICIT)

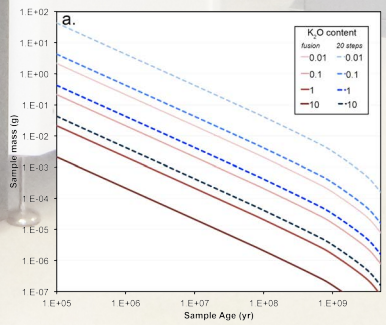
- Ultra high vacuum (UHV) noble gas extraction system achieved with oil-free ion, turbomolecular, and scroll pumps and SAES SORB-AC getters
- Manual and automatic control modes
- Janis closed-cycle cryogenic cold trap for concentration and/or separation of noble gas species

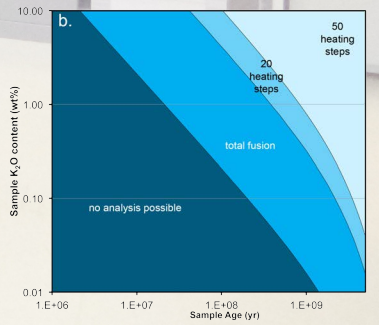
- Standard gas mixtures and cleaned air for standards
- Cross-calibrated with the Washington University noble-gas laboratory

- Nu Noblesse magnetic sector mass spectrometer with a high-voltage Nier source
- Four discrete dynode ion-counting multipliers and a Faraday cup for simultaneous counting of up to five isotopes
- Mass resolution of 3000 and ^{40}Ar sensitivity of 6.25×10^{19} cps/mol

- Complete system automation using Mass Spec software
- Integrated system control, data collection, and data reduction

MNGRL is an Investigator Facility where we work with other NASA-funded collaborators in the community. *This means you!* Please contact us for more information if you have a project in mind.





Sample K content, age, and mass for analysis in MNGRL