^{39}Ar-^{40}Ar Dating of Martian Shergottite, DaG 476. **Jisun Park[1, 2], Donald D. Bogard[1] and Daniel H. Garrison[1, 3]**, [1]ARES, code KR, NASA, Johnson Space Center, Houston, TX 77058, [2]NASA Postdoctoral Program fellow, [3]Lockheed Martin, P. O. Box 58561, Houston, TX. Jisun.park-1@nasa.gov

Basaltic Shergottite DaG (Dar al Gani) 476. was found in Libya in 1998, together with paired samples DaG 489/670/735/876/975. It has mega-size (max. 5 mm) olivine phenocrysts (10~24 %) pyroxene (54~65 %), fine-grained maskelynite (12-17%), and mesostasis, along with minor phases of opaques, impact melt glass, carbonates etc. (1-4). Dag-476 gives evidence of terrestrial weathering (1,2,3,5,6,7). The Sm-Nd age of DaG 476 was reported as 474 ± 11 Ma (7, 8). Garrison and Bogard (9) suggested several mixed trapped Ar components with older age of ~474 Ma. Walton et al. (10) reported 1427 Ma with big errors.

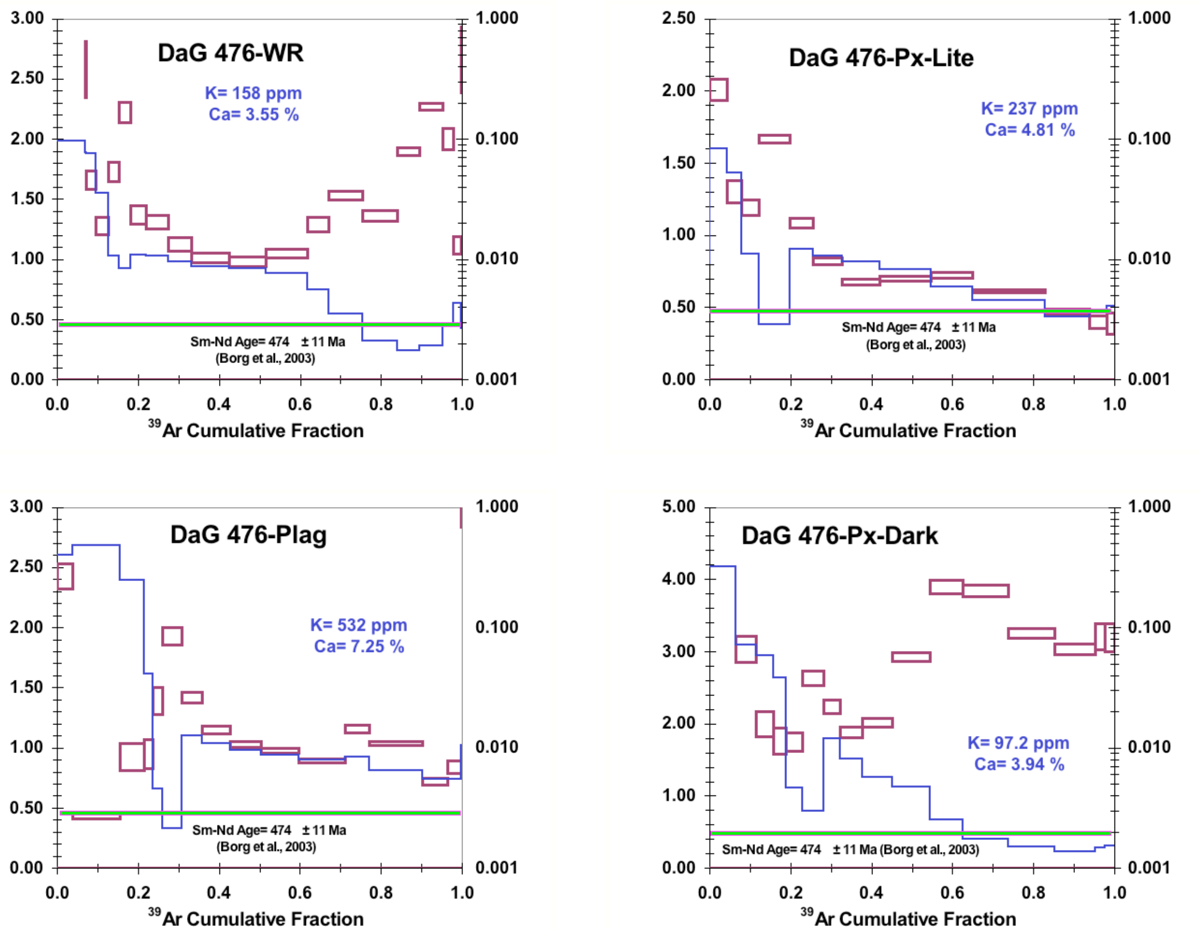
Methods. Our DaG 476 sample was kindly provided by K. Nagao, University of Tokyo. A 100-200 mesh fraction was separated into minerals by C.-Y. Shih and J. Park. Plagioclase glass (8.77 mg) was concentrated using heavy liquid with density cut at <2.85g/cm^3. Two different pyroxenes, labeled 'Lite' (Mg-rich pyroxene, 27.4 mg) and 'Dark' (Fe-rich pyroxene, 29.82 mg), were obtained with density cuts at $2.96<\rho<3.32$ g/cm^3 and $3.32<\rho<3.45$ g/cm^3, respectively. All separated samples were irradiated at the University of Missouri Research Reactor and the Ar isotopic compositions were measured on a VG-3600 mass spectrometer at NASA-JSC. DaG 476 whole rock sample had been reported by Garrison and Bogard (9).

Apparent Ar-Ar Ages & Excess ^{40}Ar. ^{39}Ar-^{40}Ar ages for whole rock (WR) and mineral separates of maskelynited plagioclase (Plag), both pyroxenes, Px-Lite and Px-Dark are shown in Figures 1-4. All apparent Ar-Ar ages are older than the Sm-Nd age of 474 ± 11 Ma (7). Ar-Ar age spectra suggest variable mixtures of terrestrial Ar (at low extraction temperatures), radiogenic Ar, and a trapped Ar component. A $^{40}Ar/^{36}Ar_{cos}$ *vs.* $^{39}Ar/^{36}Ar_{cos}$ isochron plot of DaG 476 WR, with 7~62% of ^{39}Ar release, gives an age of 882 Ma. A $^{40}Ar/^{36}Ar_{cos}$ *vs.* $^{39}Ar/^{36}Ar_{cos}$ isochron plot of DaG 476 Plag with 36~71 % of ^{39}Ar release, gives an age of 619±31 Ma. The isochron age of DaG 476-Px-Lite, with 25~83% of ^{39}Ar release, gives an age of 408±172 Ma. DaG-Px-Dark does not define an isochron.

We calculated the amounts of excess ^{40}Ar in each Dag-476 sample by subtracting from total ^{40}Ar that amount of ^{40}Ar that would have accumulated over 474 Myr. Table 1 shows that these excess ^{40}Ar concentrations range over 5~22.4 x10^{-7} cm^3/g. This range of excess ^{40}Ar concentrations is identical to that determined in Zagami and several other shergottites (11, 12). These authors concluded that excess ^{40}Ar in many shergottites was inherited from the magma, and is not a component implanted from the martian atmosphere, as occurs in shergottite impact glass.

Terrestrial Weathering. The terrestrial age of Dag-476, based on ^{81}Kr-Kr analysis, was reported as 140 Ma (13), which probably accounts for the observed evidence of significant terrestrial weathering (1,2,3,5,6,7). We found that 60% of ^{40}Ar, 50% of ^{38}Ar and 73% of ^{36}Ar in DaG 476-WR were extracted at the first temperature fraction. For DaG 476-Plag and DaG 476-Lite about 10% of ^{40}Ar, ^{38}Ar, ^{36}Ar and less than 1% of ^{40}Ar, ^{38}Ar, ^{36}Ar, were extracted at the first temperature fraction, respectively. 57% of ^{40}Ar, 16% of ^{38}Ar and 74% of ^{36}Ar in DaG 476-Px-Dark were extracted at the first temperature fraction of 300ºC. Consequently, the DaG 476-Px-Dark which composed of Fe rich pyroxene was easily weathered by terrestrial contamination, but Mg-rich pyroxene was more resistant to weathering.

Conclusions. Ar-Ar analyses of DaG 476 whole rock, plagioclase glass, and two pyroxene separates give apparent Ar-Ar ages much older than the reported Sm-Nd age (7). These Dag-476 samples show identical concentrations of excess, trapped Ar to several other shergottites. We conclude that the origin of much of the excess



Figures 1-4. ^{39}Ar-^{40}Ar ages (rectangles, left axis) and K/Ca rations (stepped line, right axis) for stepwise temperature extractions of DaG476 separates. The pink color-line indicates the Sm-Nd age reported by (7).

^{40}Ar in shergottites was from the shergottite magma (11, 12). But, DaG 476 samples, especially Fe-rich pyroxene, show greater effects of terrestrial weathering compared to most shergottites.

Table 1. Excess ^{40}Ar in Zagami Mineral Separates (units cc/g and percent of total ^{40}Ar).

	^{40}Ar excess (cc/g)	^{40}Ar excess (%)
DaG476-WR	9.64E-07	75.4
DaG476-Plag	1.40E-06	59.7
DaG476-Px-Lite	5.05E-07	53.4
DaG476-Px-Dark	2.24E-06	92.5

References.

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