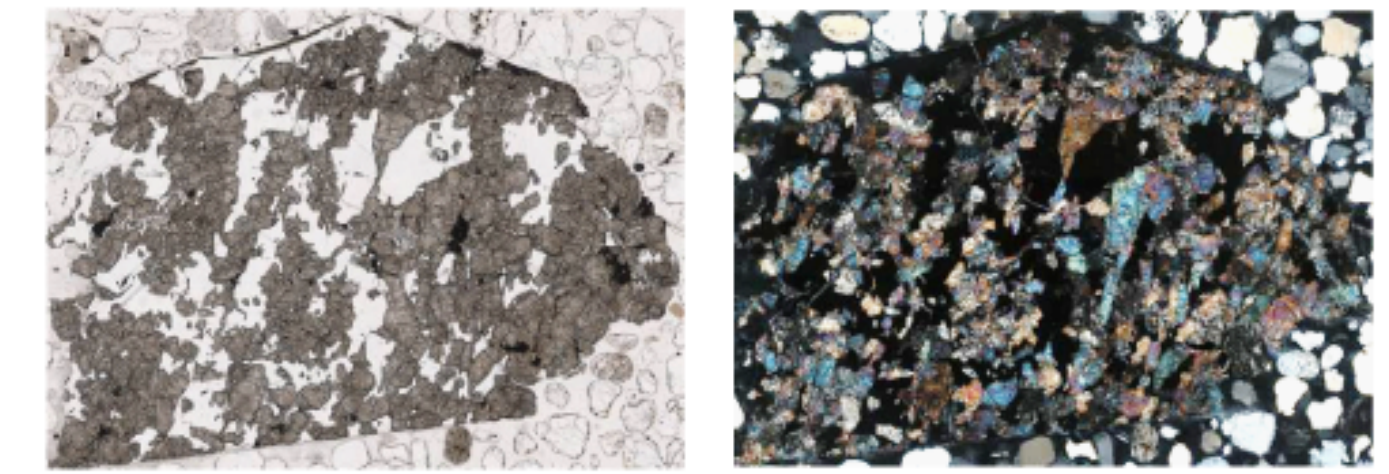


# Ar/Ar Systematics of Martian Meteorite NWA 2975

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Photos from Alan Tindle, Open University: <http://www.open.ac.uk/earth-research/tindle>

## Introduction

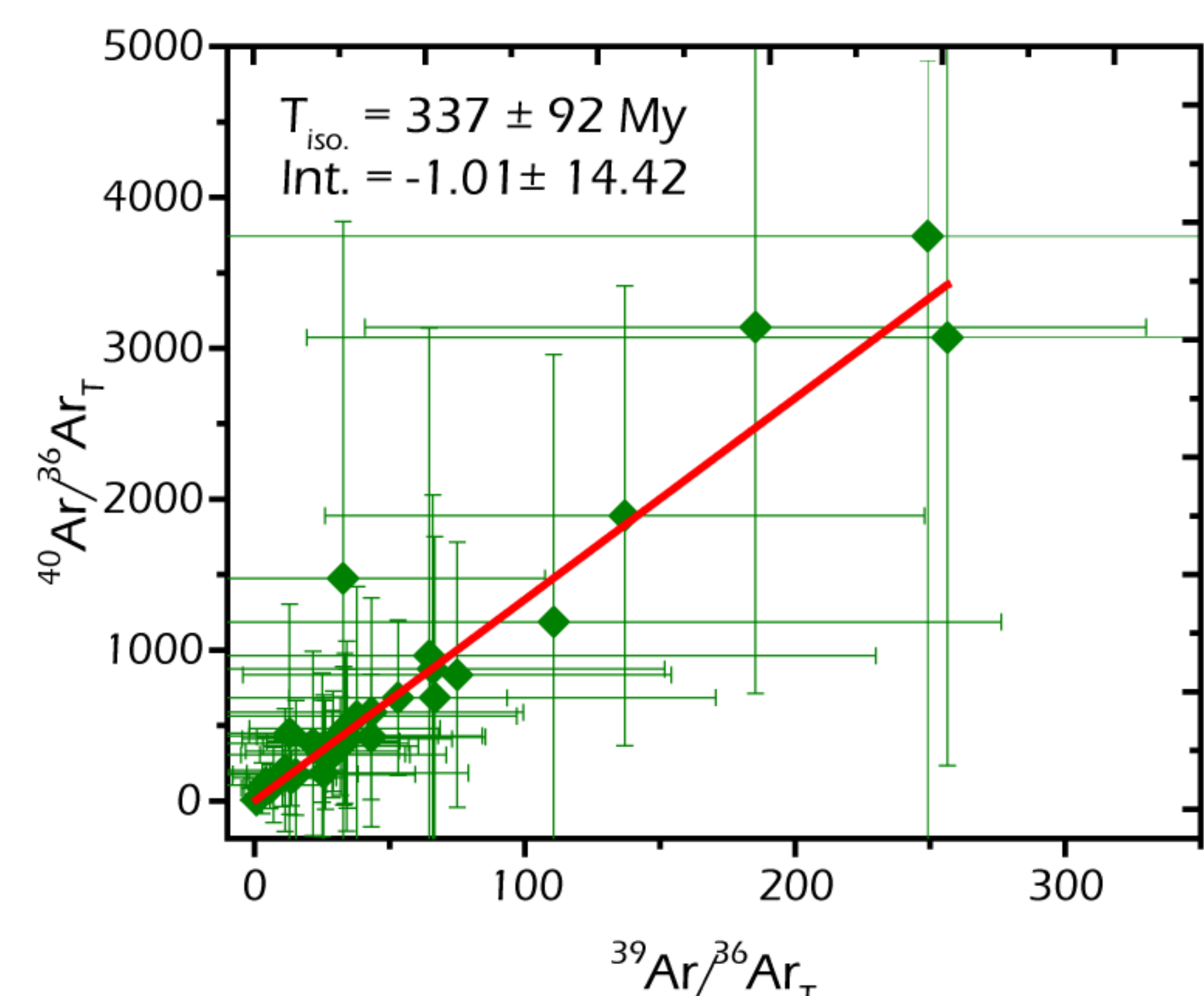
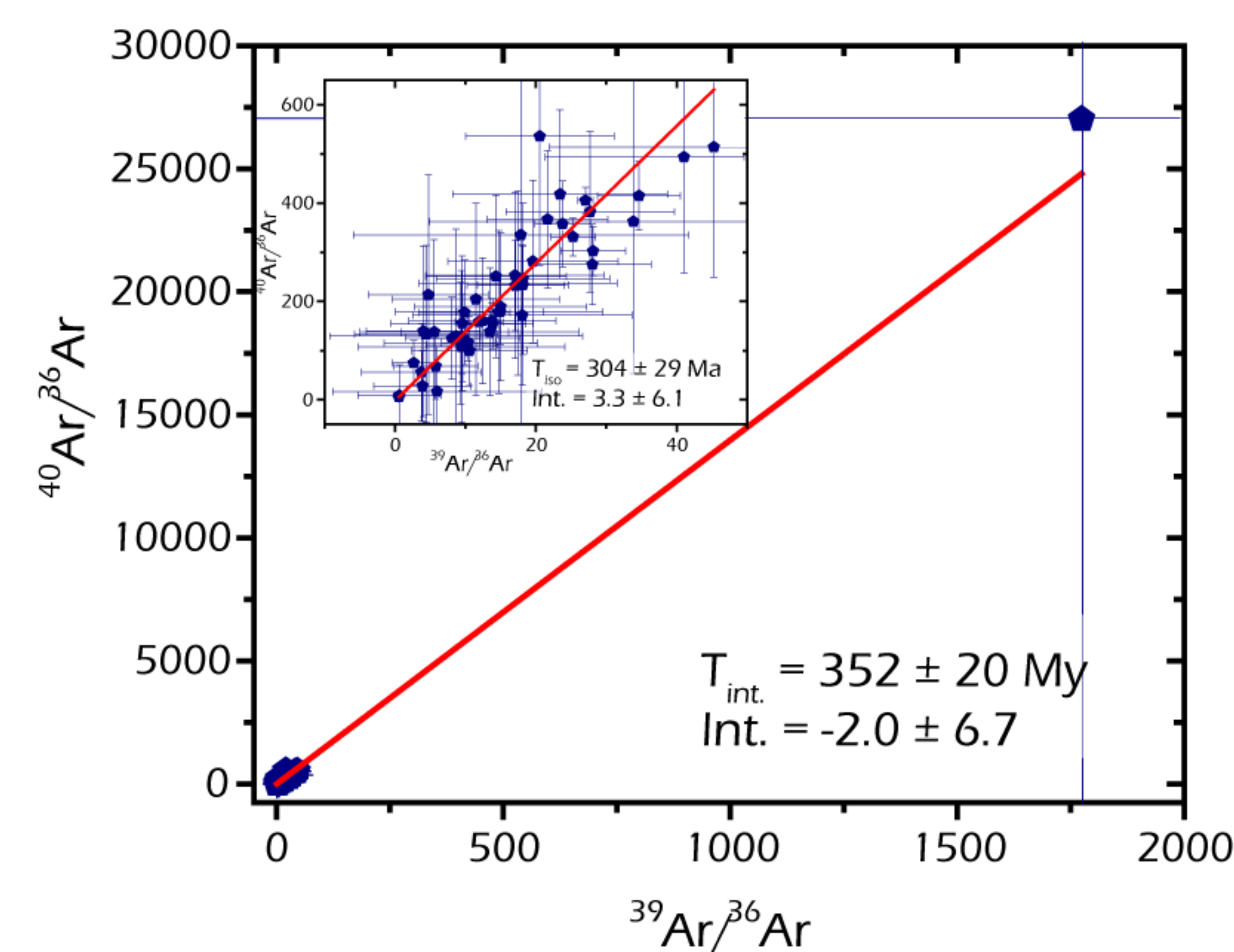
NWA 2975, an enriched martian basaltic shergottite, is highly shocked and relatively unweathered<sup>1,2</sup>. The maskelynized plagioclase in its groundmass is homogeneous and usable for geochronological studies. We use NWA 2975 maskelynite to address the conundrum of martian Ar-Ar ages that are older than Sm-Nd ages. Our approach uses smaller samples (single grains) to study the Ar-Ar systematics of this meteorite.

## Experimental Conditions

We chose 7 grains based on relatively high [K] as found by semi-quantitative energy dispersive spectroscopy (EDS) work. The grains were irradiated (with Cd shielding) for 80 h at the USGS Triga reactor and heated in 7 - 10 steps with a CO<sub>2</sub> laser ( $T_{\text{max}} = 1400^\circ\text{C}$ ). Ar isotopes were analyzed using a MAP 215-50 spectrometer operated in pulse-counting mode. A typical system blank ( $10^{-17}$  mol) is:  $^{40}\text{Ar} = 8.21$ ;  $^{39}\text{Ar} = 0.37$ ;  $^{38}\text{Ar} = 0.03$ ;  $^{37}\text{Ar} = 1.35$ ;  $^{36}\text{Ar} = 0.13$ . Fish Canyon sanadine (28.2 Ma) was used as a flux monitor.

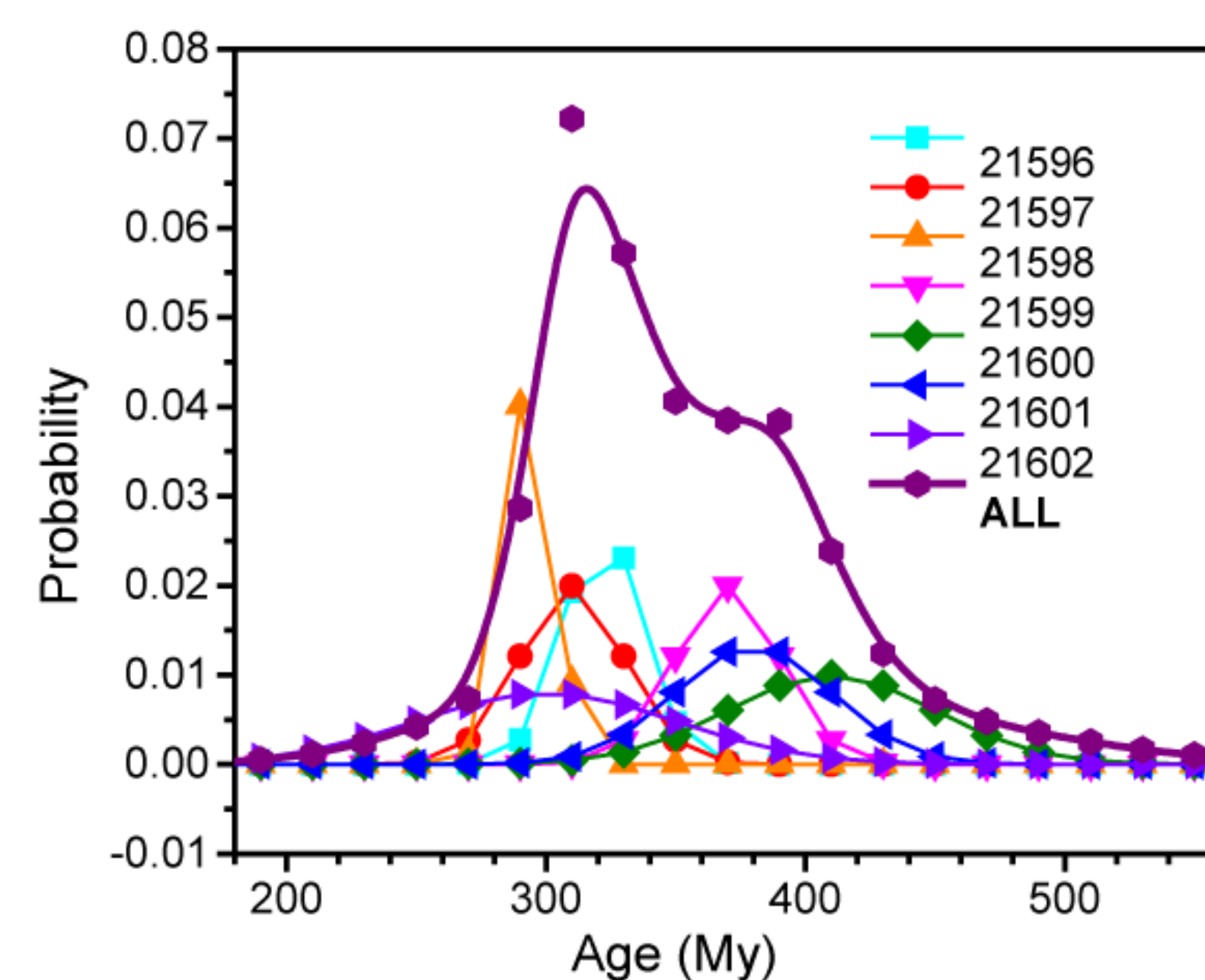
## Isochrons

A standard isochron, with no corrections (left graph), yields an age of  $352 \pm 20$  My. The inset shows the same isochron without the high outlying point, in which case, the age decreases to  $304 \pm 29$  My. In both cases, the intercept is 0, within error ( $1\sigma$ ). Calculating the cosmogenic  $^{36}\text{Ar}$ ,  $^{36}\text{Ar}_c$ , by assuming that the minimum measured  $^{36}\text{Ar}/^{37}\text{Ar}$  represents purely cosmogenic  $^{36}\text{Ar}$ , we can fit the isochron by using only the trapped component of  $^{36}\text{Ar}$  for both ratios (right graph). This decreases the age slightly to  $337 \pm 92$  My, yet retains an intercept of zero, indicating no trapped  $^{40}\text{Ar}$  (points with unreliable  $^{36}/^{37}\text{Ar}$  are omitted).



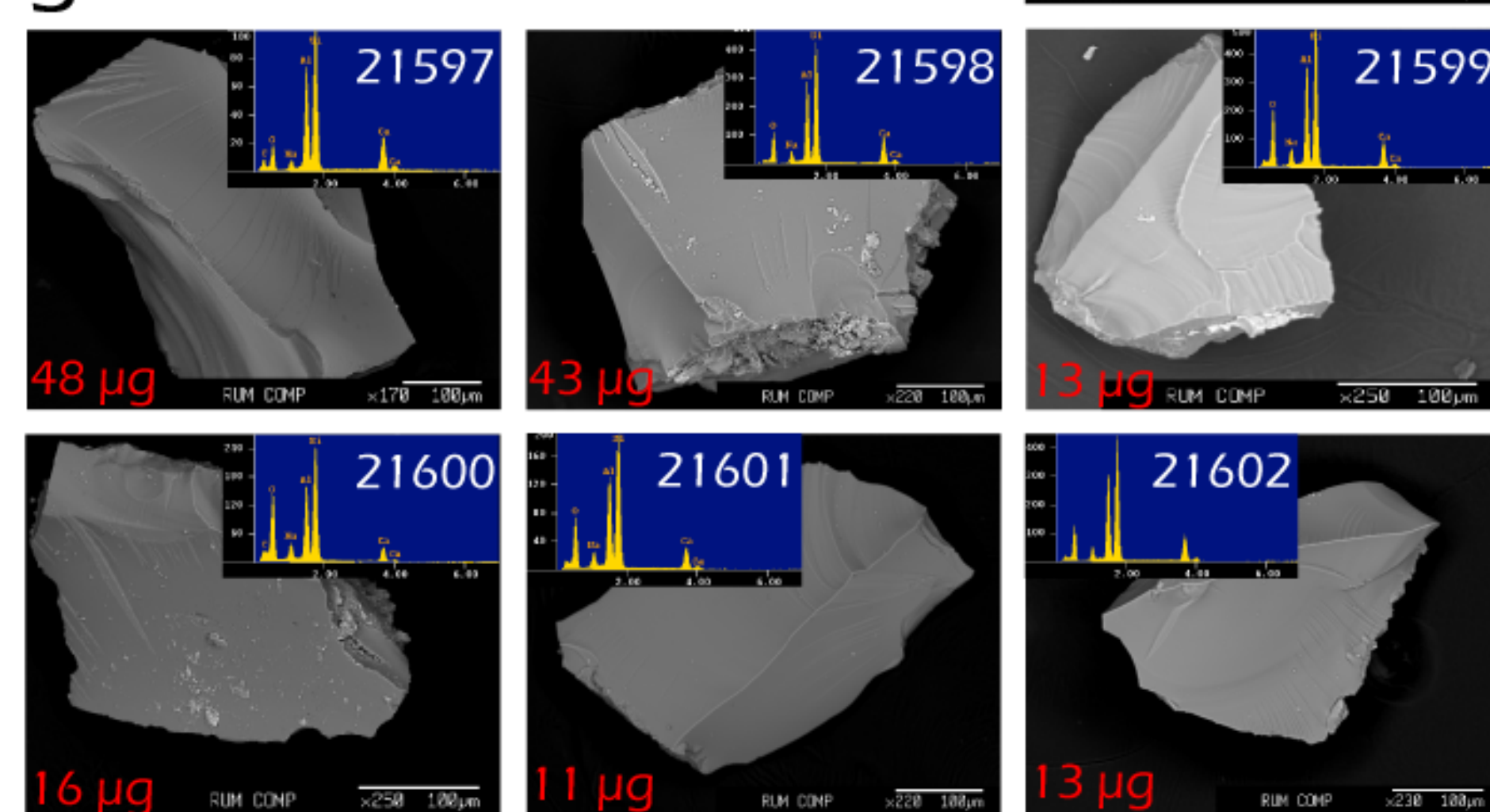
## Probability Curve

Plateau ages describe a single population within  $2\sigma$  error.



## Grains

Backscatter electron images and energy dispersive spectra of single maskelynite grains.



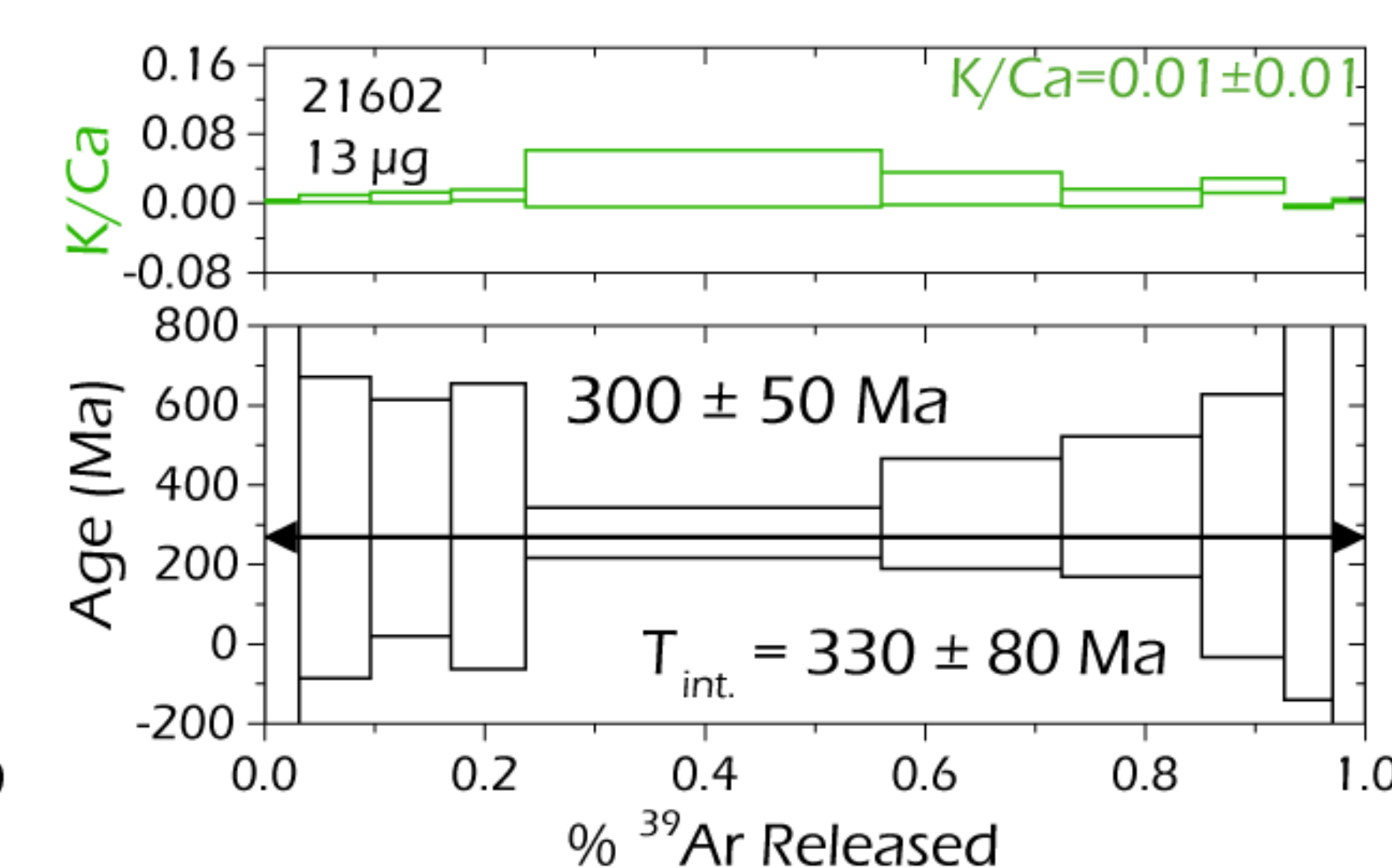
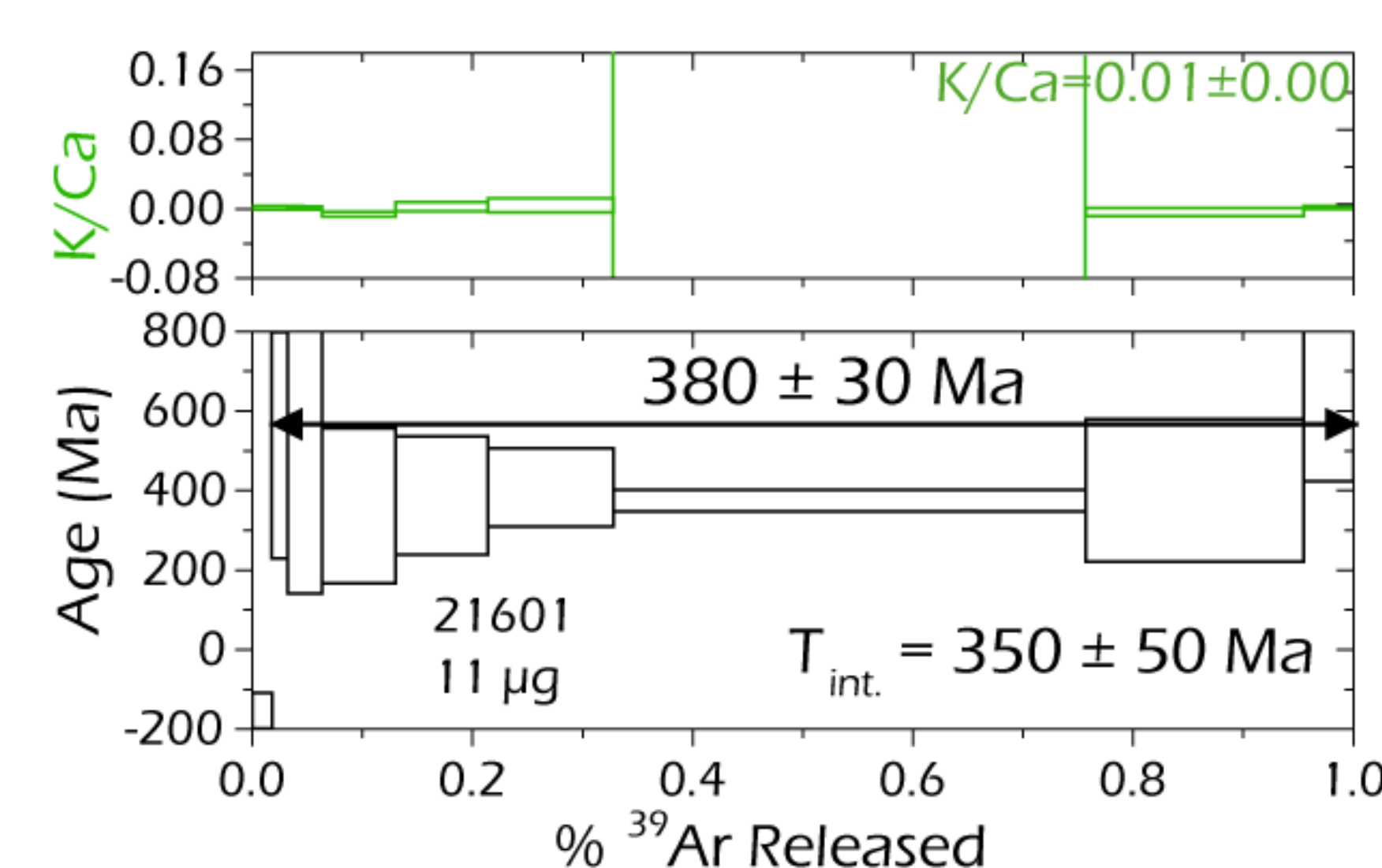
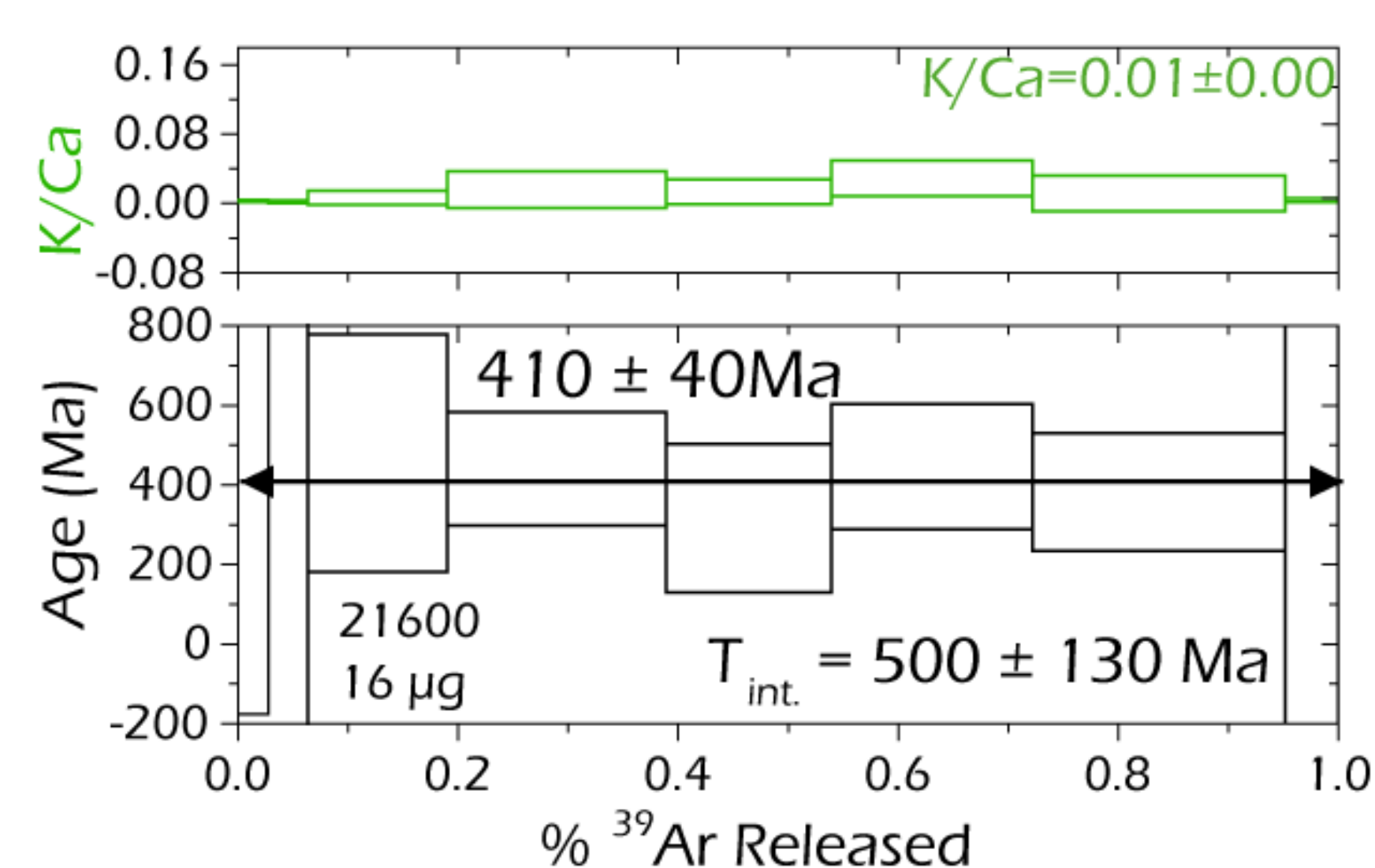
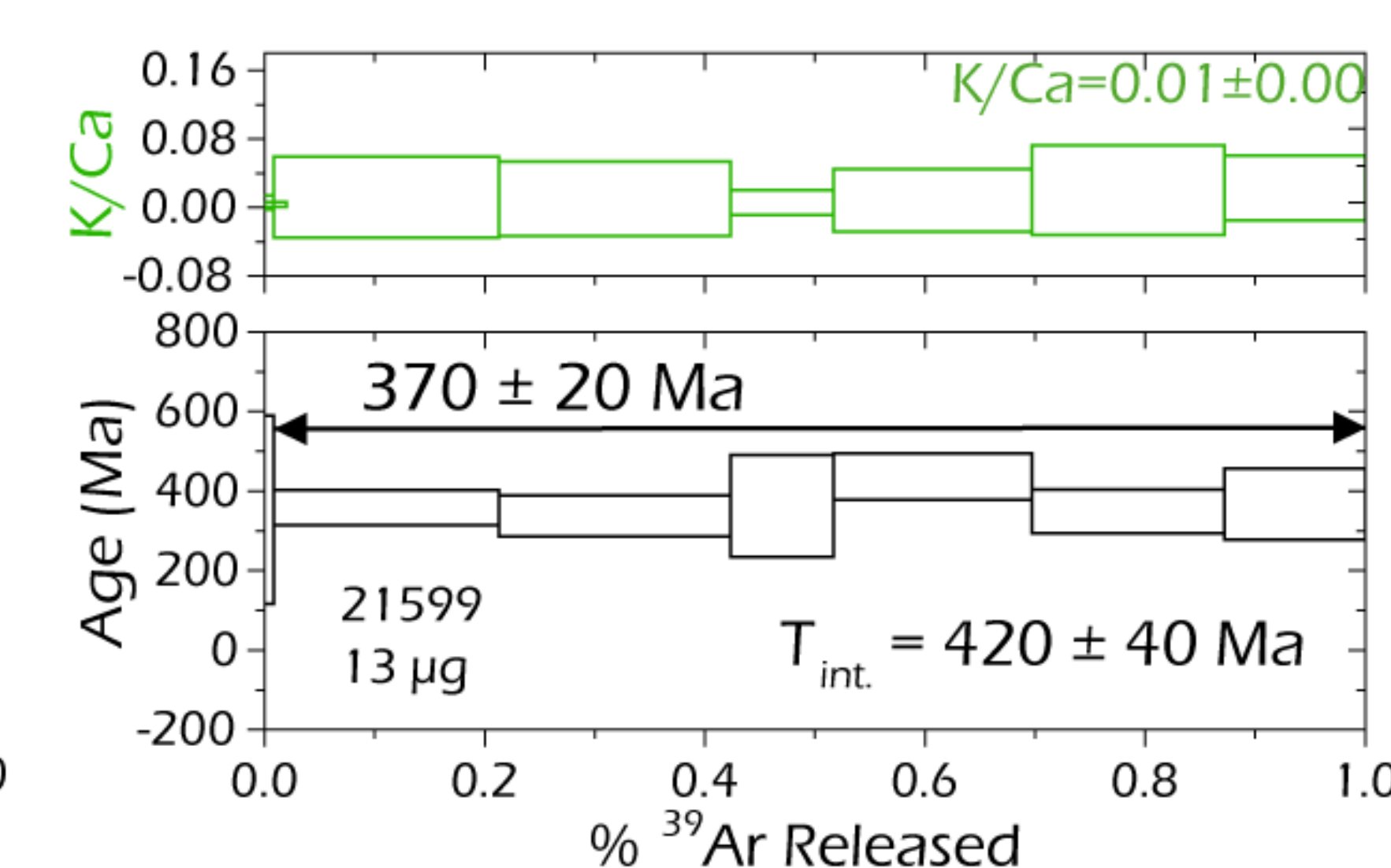
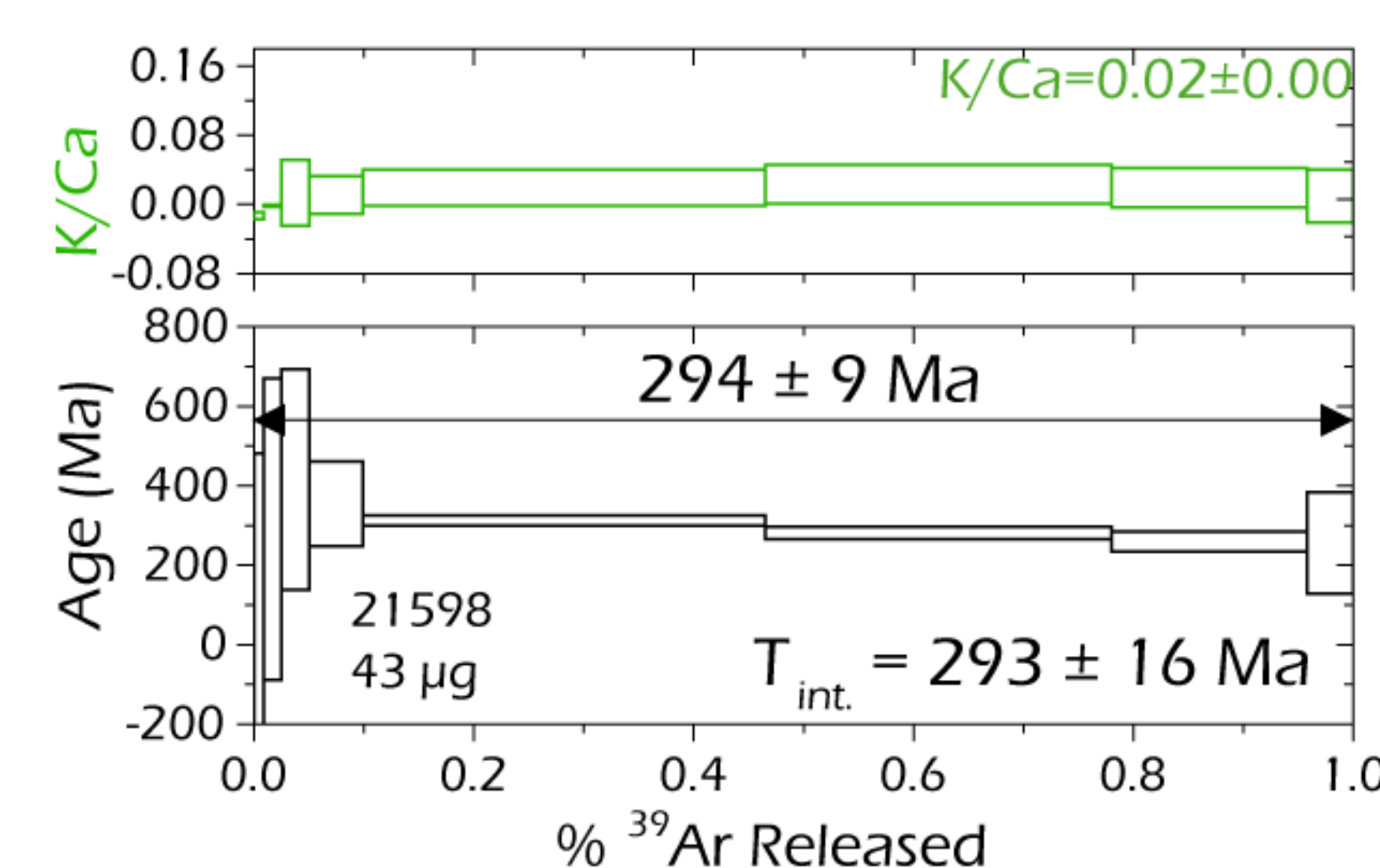
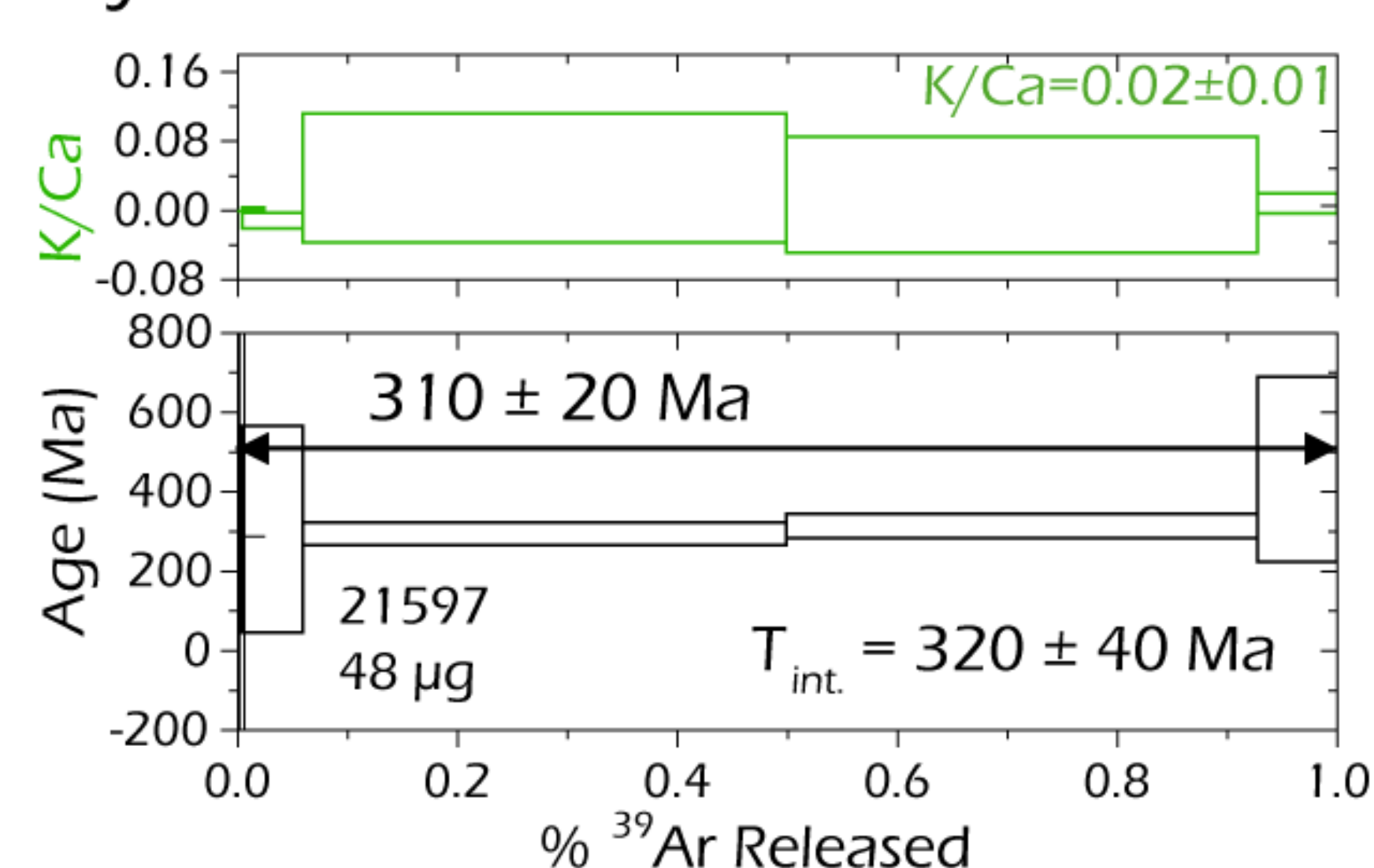
## Plateau Diagrams

Apparent ages range from 294 to 410 My.

Wtd. avg. is  $314 \pm 7$  My.

Ages are concordant with total fusion ages.

All samples give apparent ages older than Sm-Nd values of  $\sim 180$  My<sup>3</sup>.



## Summary

$^{40}\text{Ar}/^{39}\text{Ar}$  ages of maskelynite grains are  $\sim 325$  My.

Cosmogenically corrected isochron shows no evidence of excess  $^{40}\text{Ar}$  and gives an age of 337 My.

## Conclusions

A shock event reset the maskelynite grains sometime before 290 My.

This event is not the same as the launching impact event.

The discrepancy between the Ar-Ar and Sm-Nd systems is real, but not yet understood.

Smaller samples capture fine-scale heterogeneity within martian meteorites.

[1] Sanborn & Wadhwa (2010) 73rd METSOC # 5294; [2] Connolly et al. (2006) Met. Bull., 90:1387; [3] Park et al. (2013) *In  $^{40}\text{Ar}/^{39}\text{Ar}$  dating: from geochronology to thermochronology, from archaeology to planetary sciences.* *In Press.*