Varied H concentration and isotopic composition in the Lunar Interior

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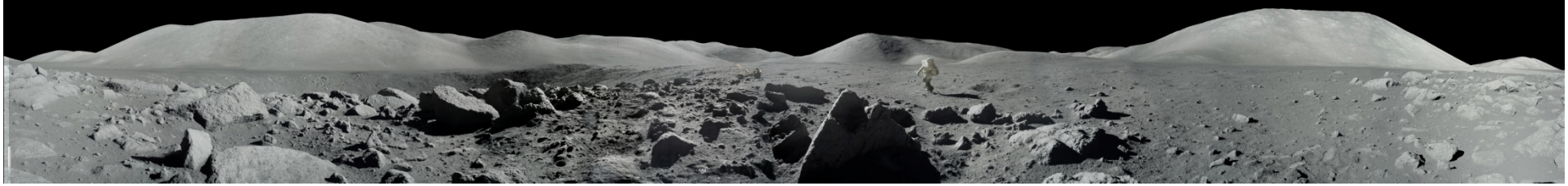
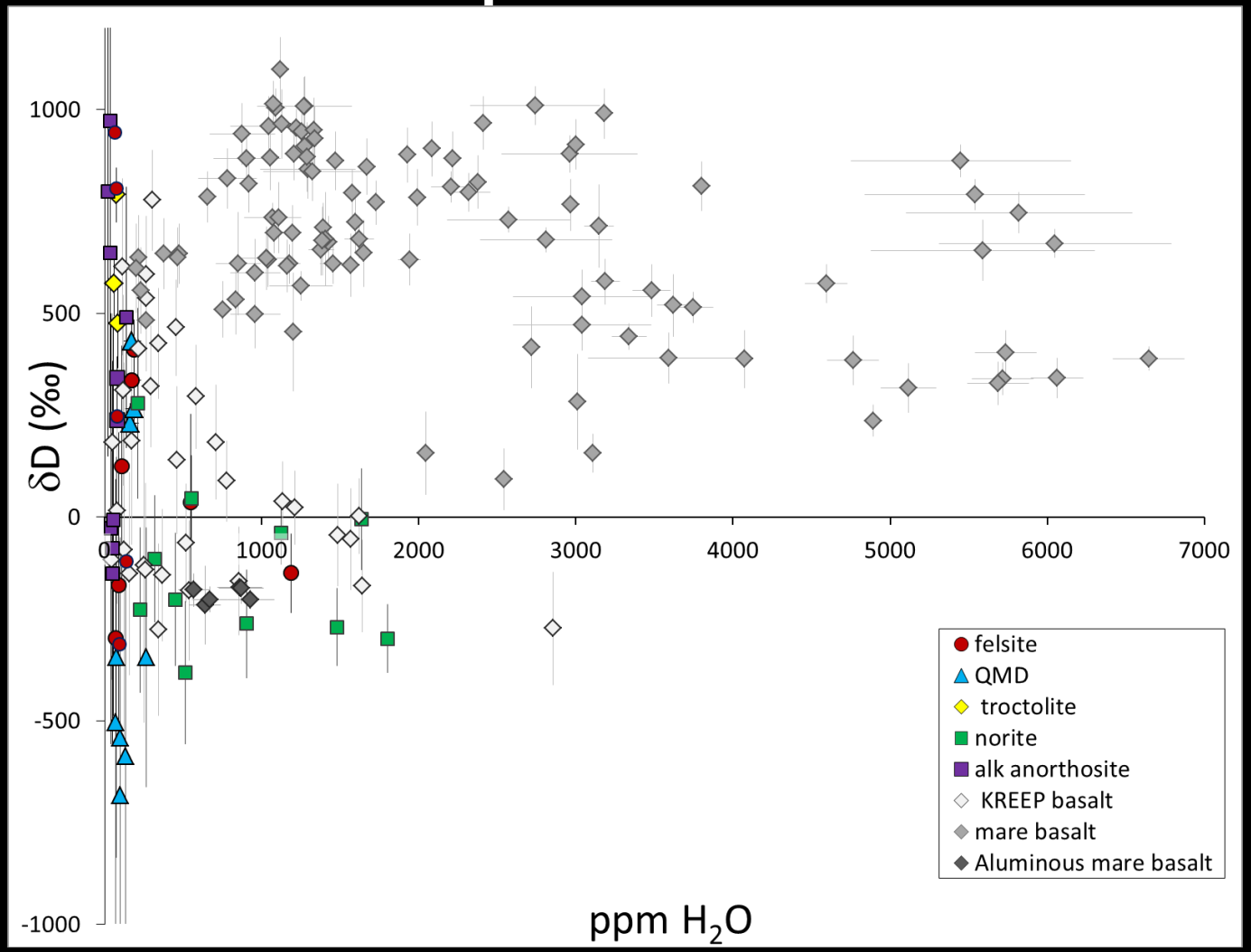
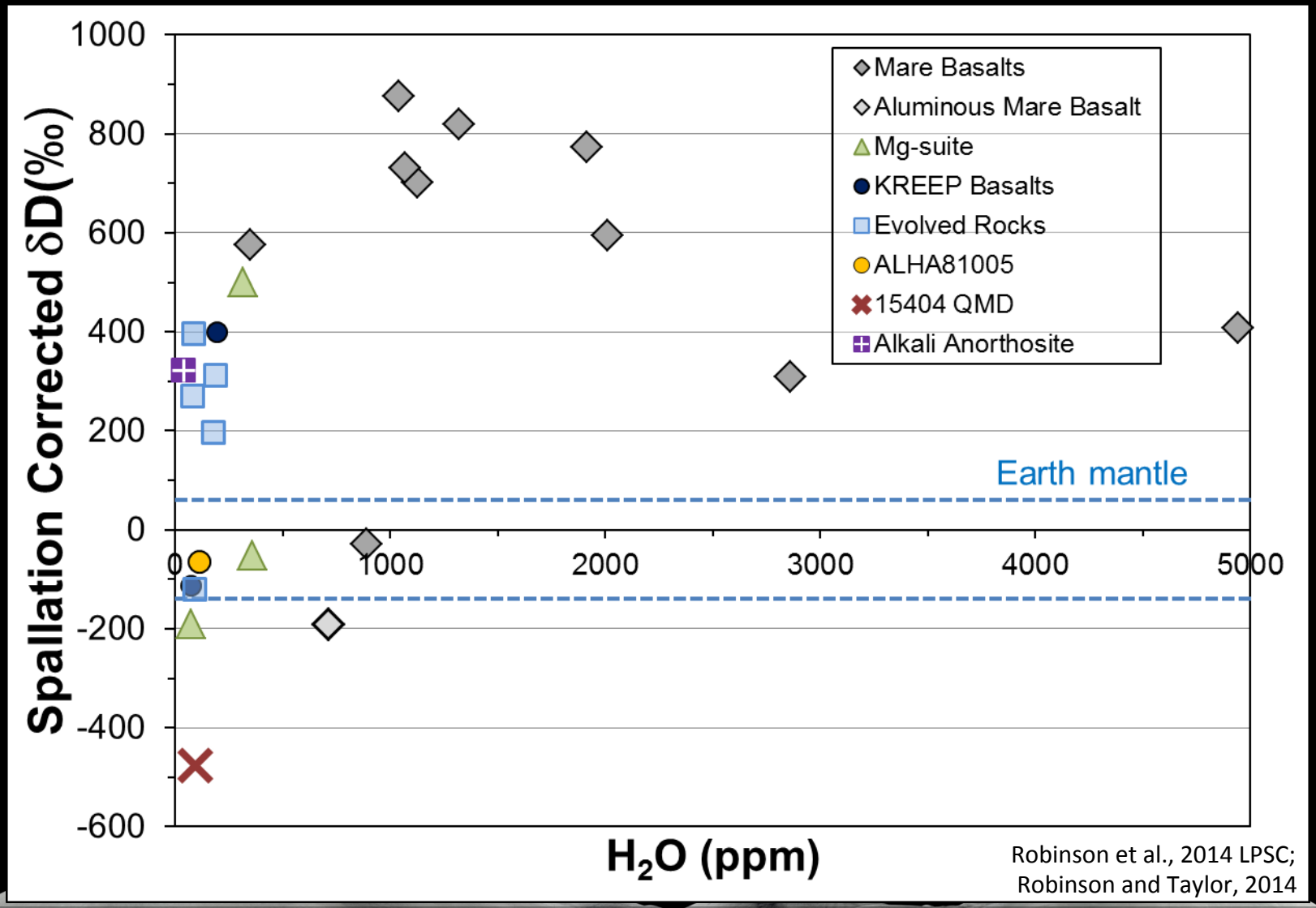


All Apatite Data



Data from Greenwood et al., 2011; Barnes et al., 2013, Tartese et al., 2013, Tartese et al., 2014, Barnes et al., 2014,Robinson et al., 2013, 2014, Robinson and Taylor, 2014

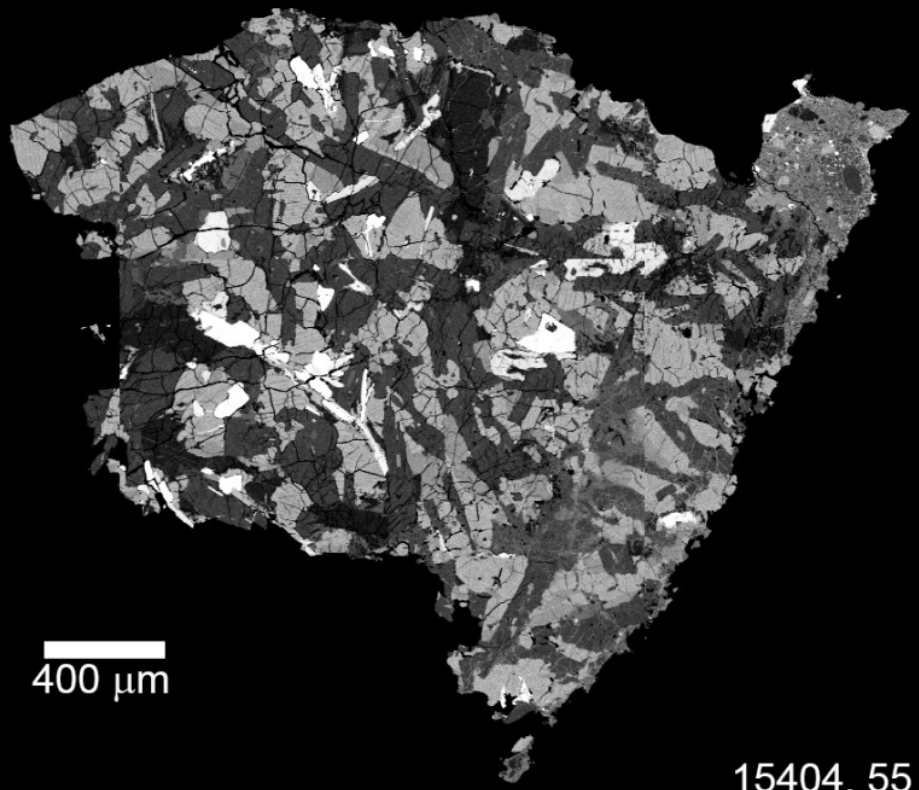
Multiple Reservoirs



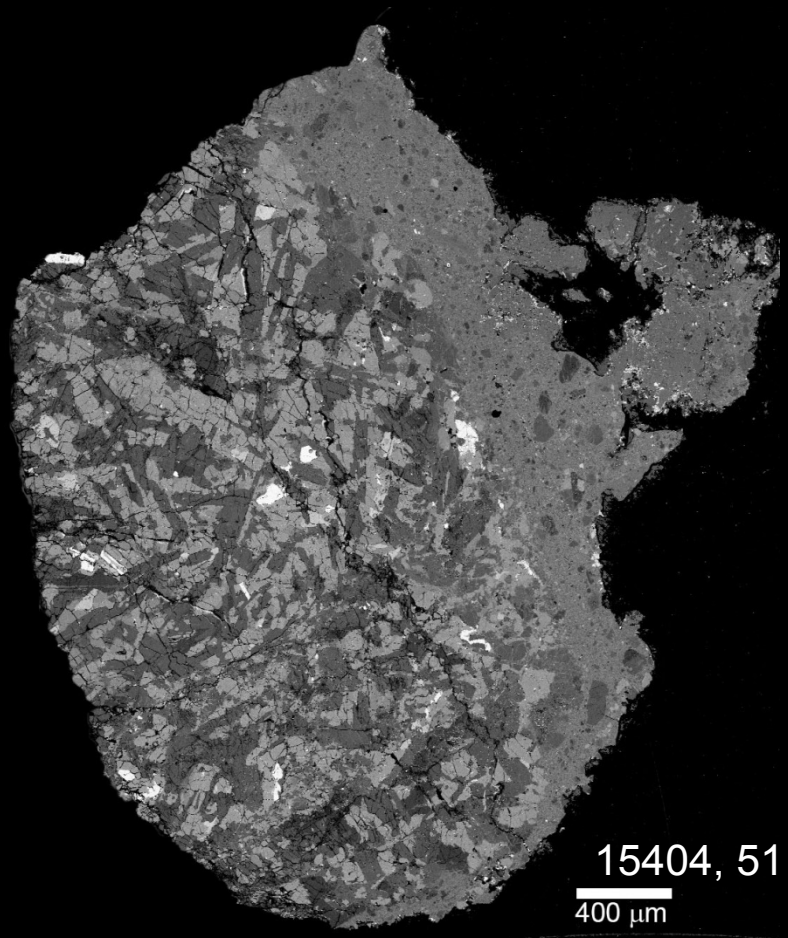
Robinson et al., 2014 LPSC;
Robinson and Taylor, 2014

Data also from Greenwood et al., 2011; Barnes et al., 2013, Tartese et al., 2013, Tartese et al., 2014, Barnes et al., 2014,Robinson et al., 2013

Apollo 15 QMDs

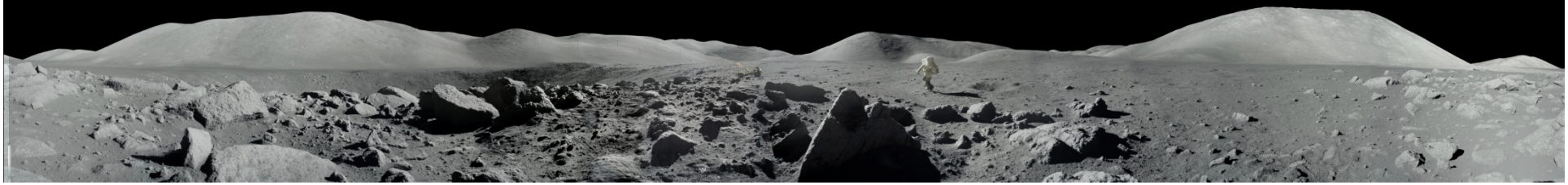


15404, 55

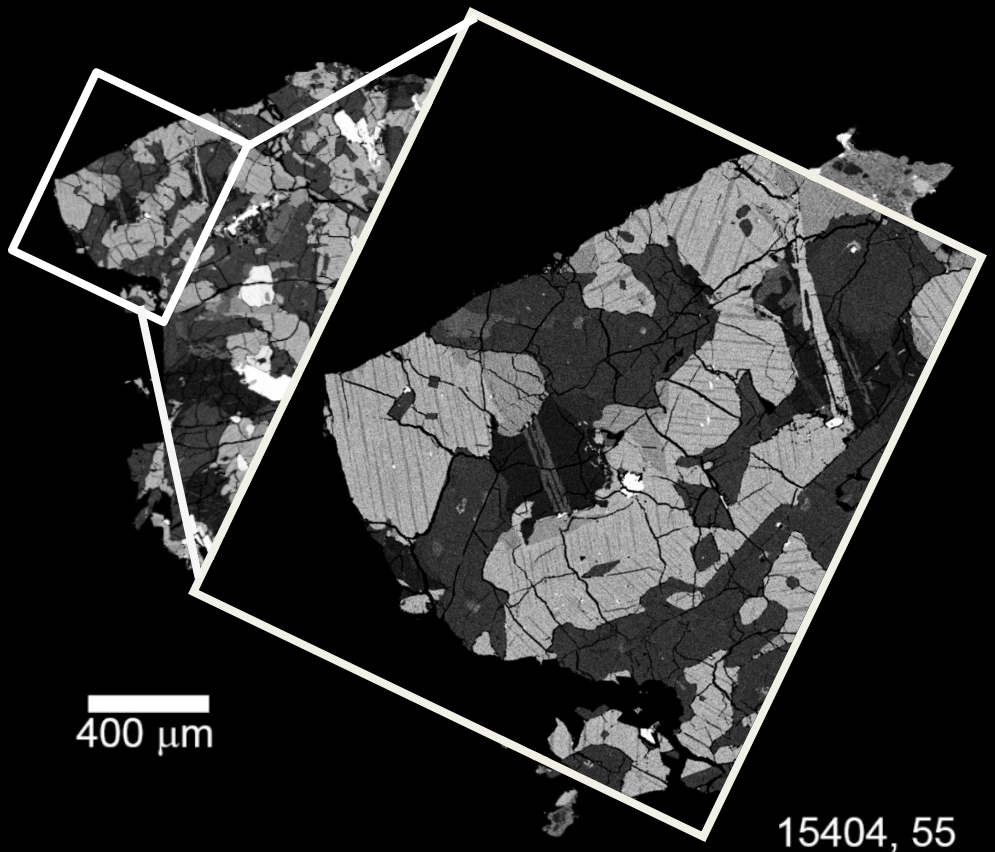


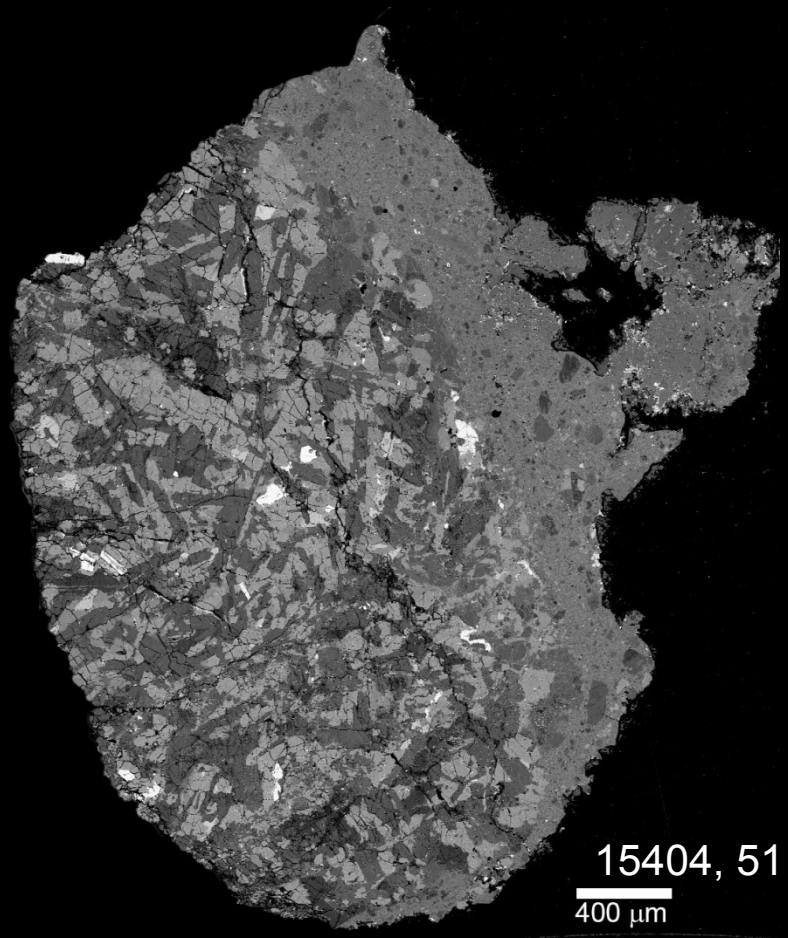
15404, 51

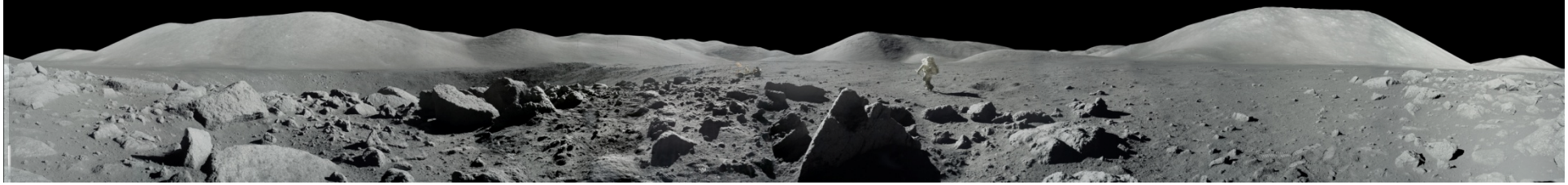
400 µm



Apollo 15 QMDs

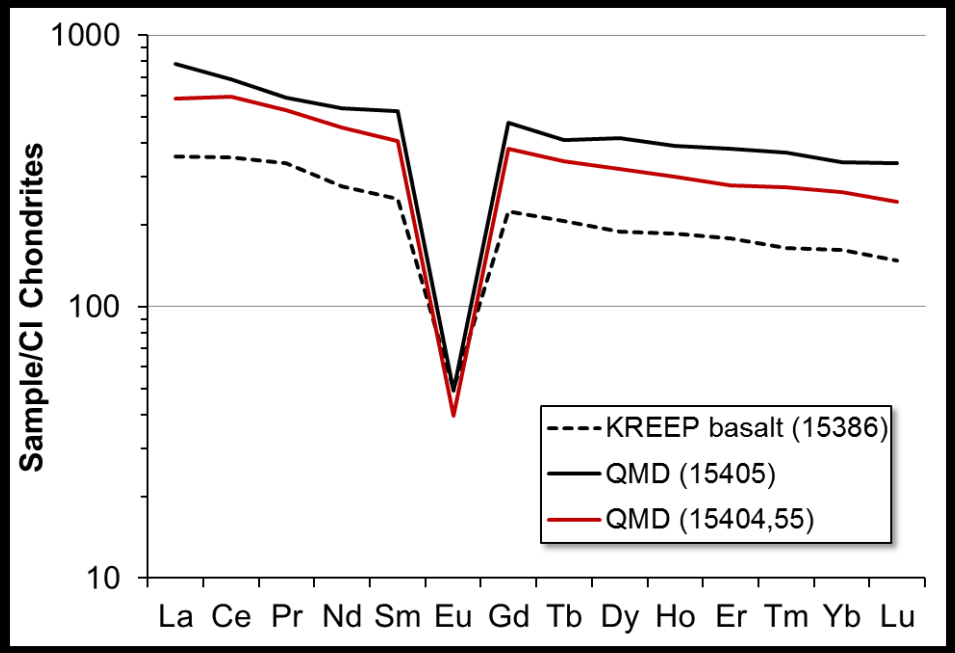




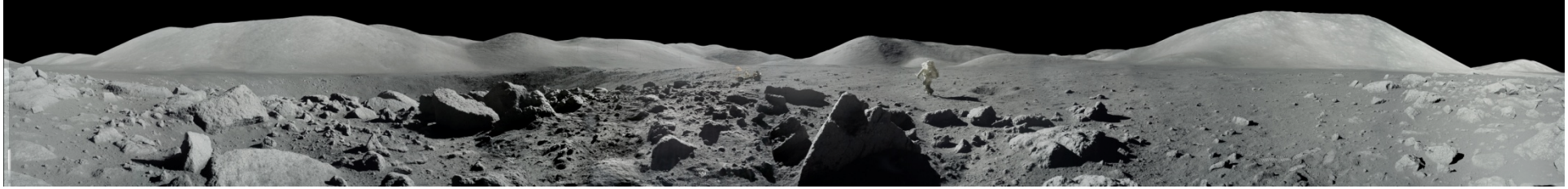


Apollo 15 QMDs

- Fe rich, higher REEs than A15 KREEP
- Exsolved pyroxenes indicate intrusive origins
- Young CRE age (11Ma, from 15405)
- Fragments probably derived from impact melt breccia 15405

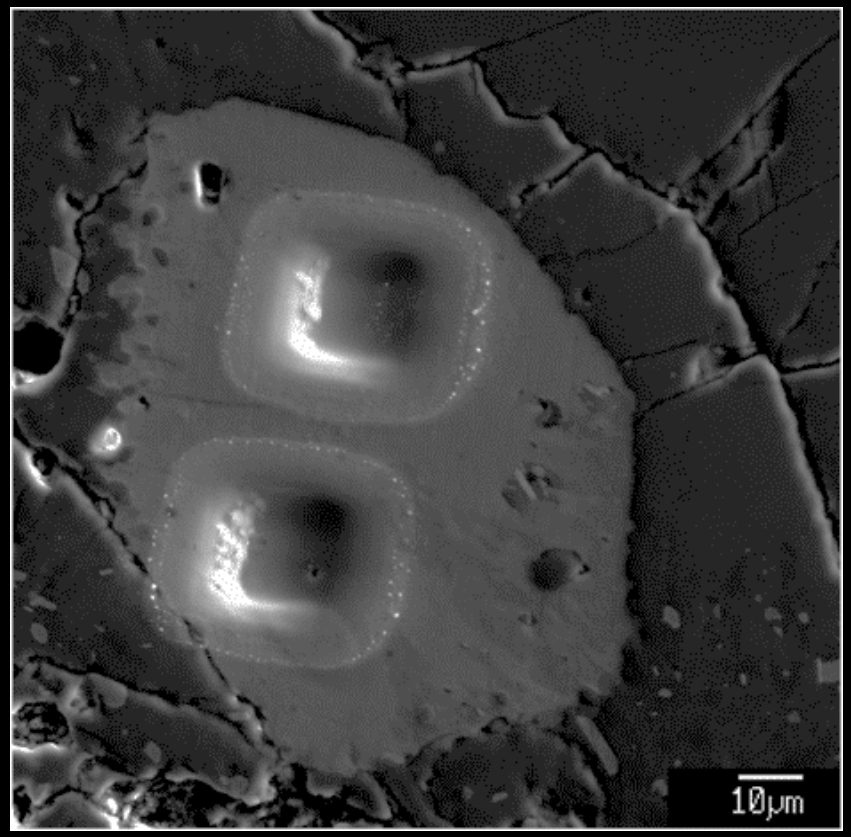


REE data for 15404, courtesy of D. Mittlefehldt

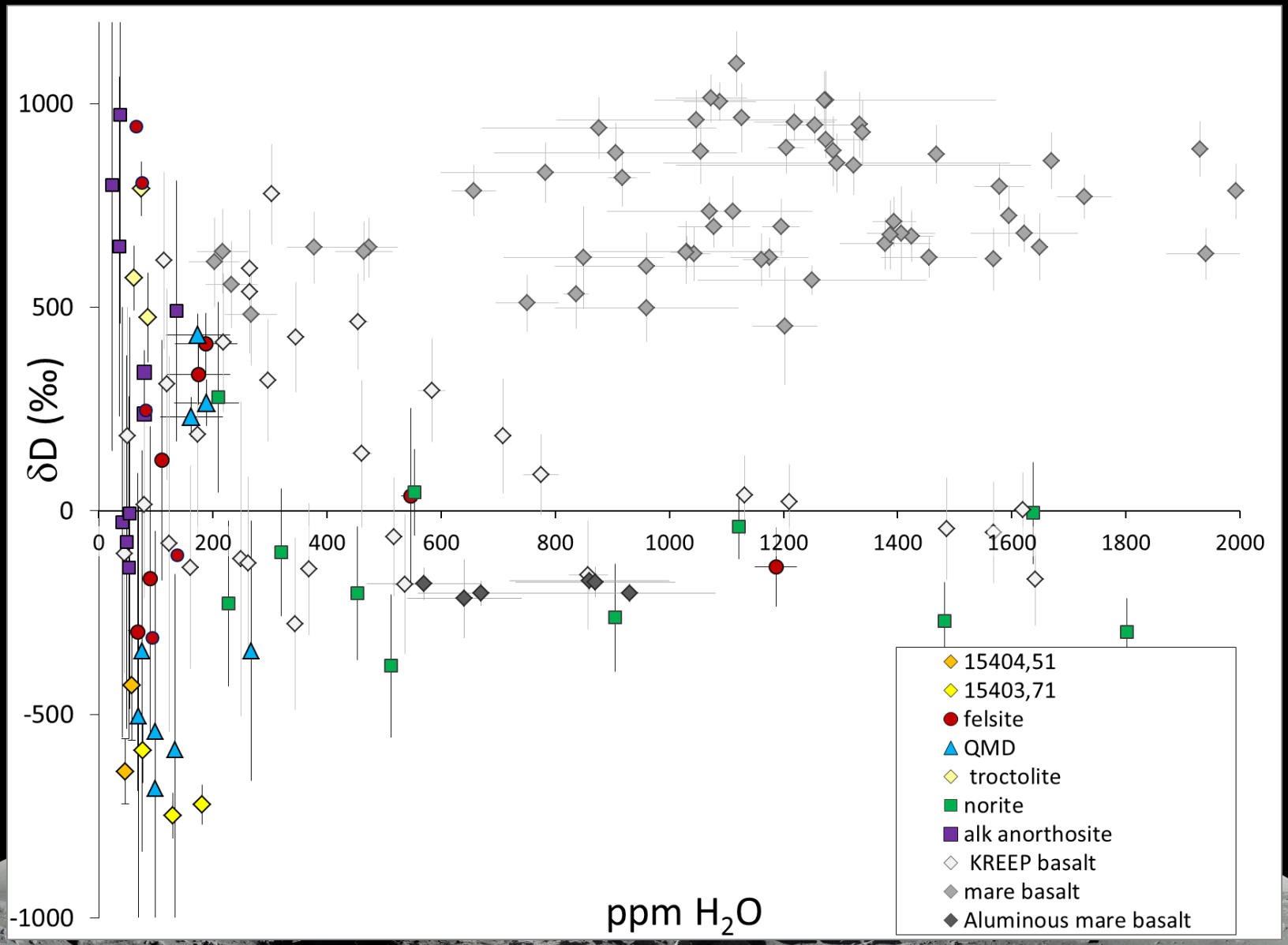


Methods

- University of Hawaii Cameca ims 1280
- Open University 50L NanoSIMS
- Cs^+ primary beam
- H_2O content calculated using H_2O-$^1H/^{18}O$ calibration curve



Results



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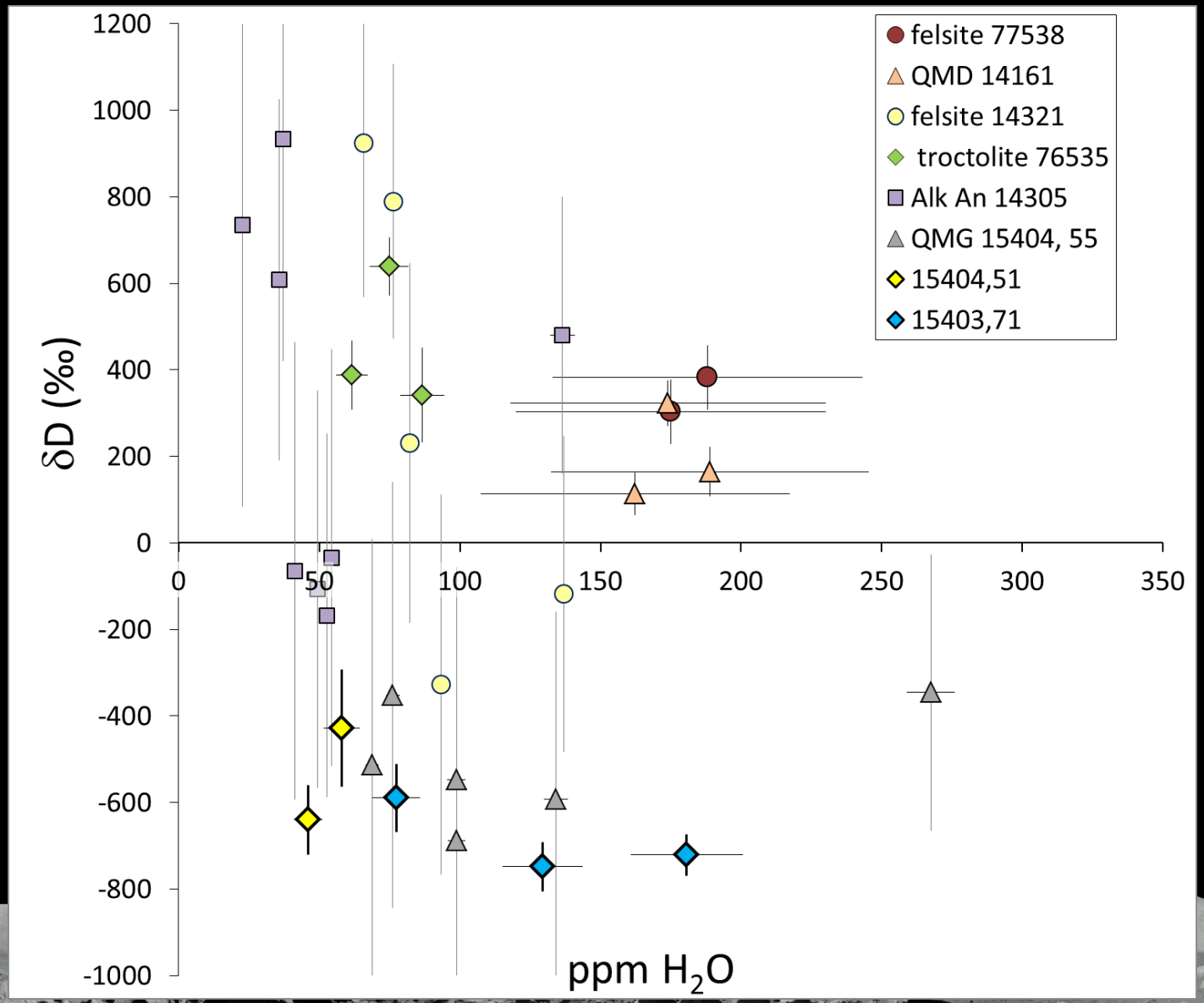

felsite 77538
QMD 14161
felsite 14321
troctolite 76535
Alk An 14305
QMG 15404, 55
15404,51
15403,71
δD (‰)
ppm H_2O
1200
1000
800
600
400
200
0
-200
-400
-600
-800
-1000
0
50
100
150
200
250
300
350

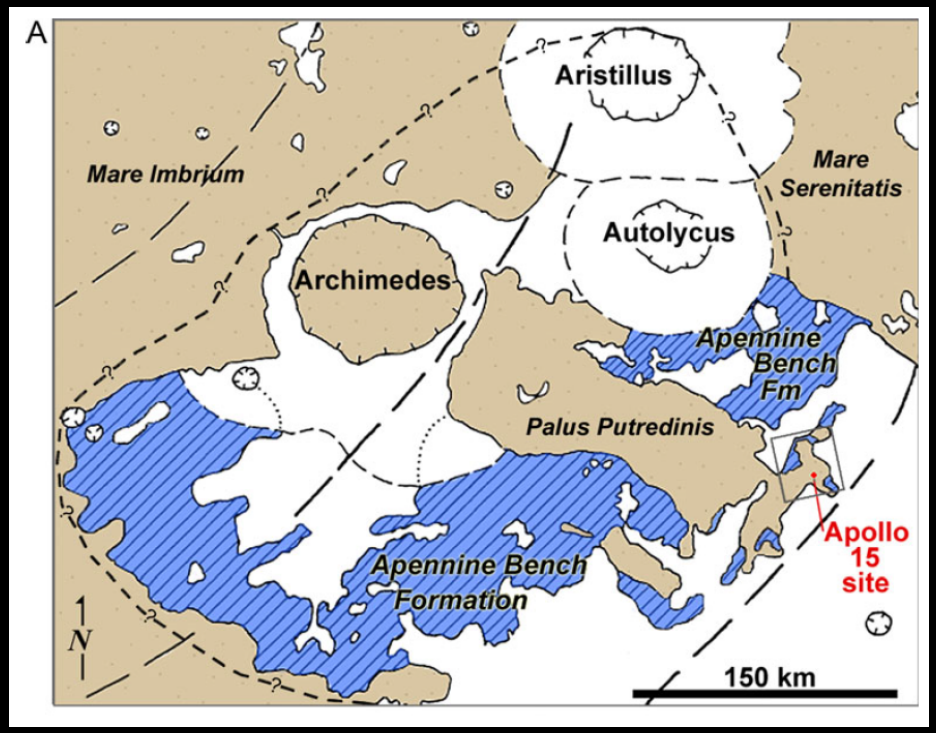
Solar Wind Contamination

- Not in original igneous rocks (cumulates)
- Not when sitting on the surface
- Could it be incorporated into the impact melt?

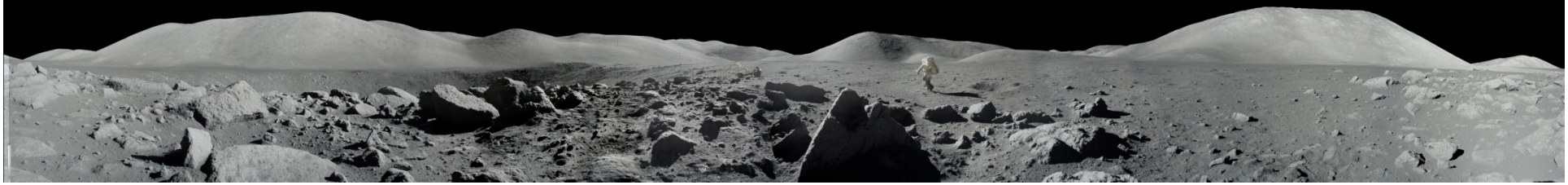
NASA Apollo 15 photograph AS15-90-12187.)

Impact Melt and Solar Wind

- Implanted solar wind could have been incorporated into impact melt during Aristillus formation
- Did this affect apatite clasts or apatite in rock clasts?
- Modeling in progress



Taylor et al., 2012



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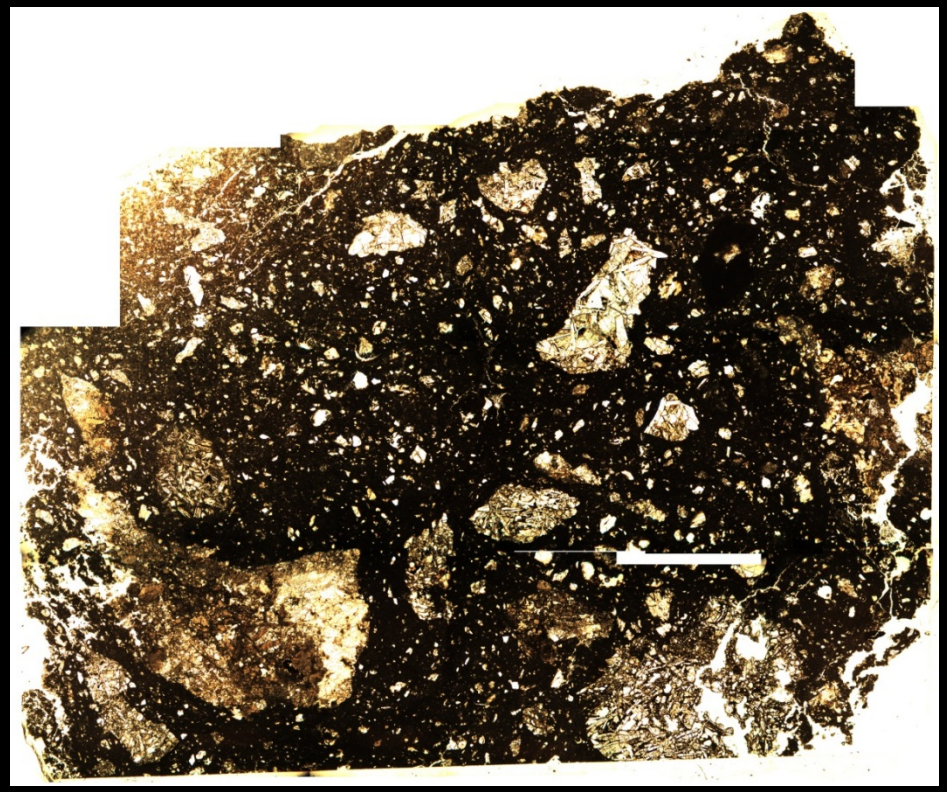

15405, 12

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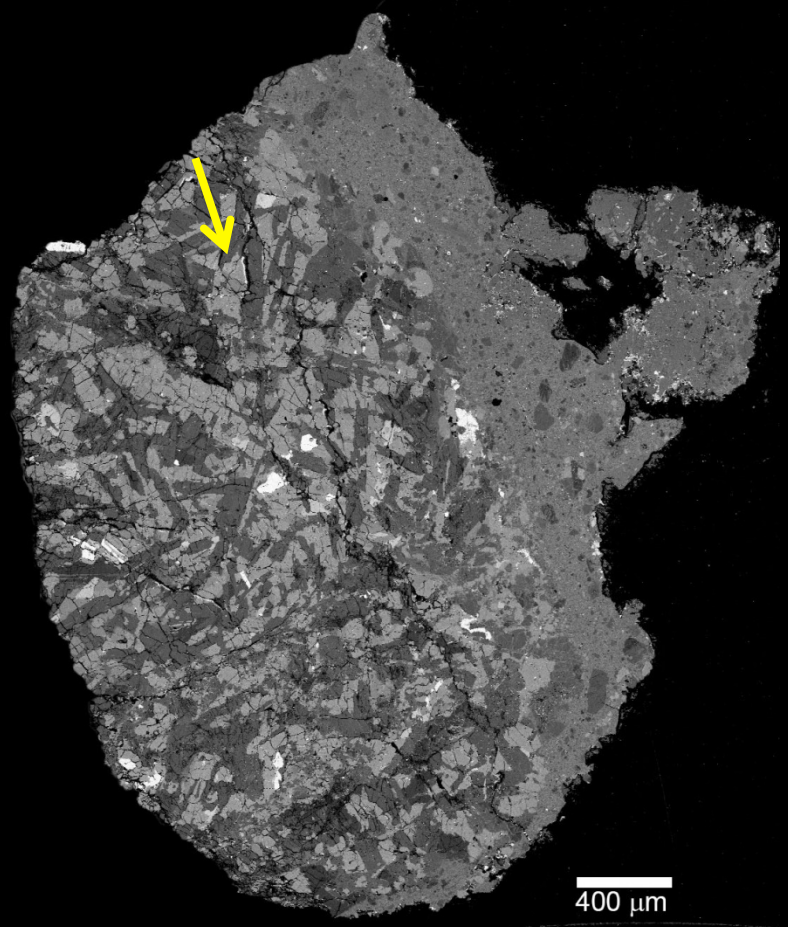
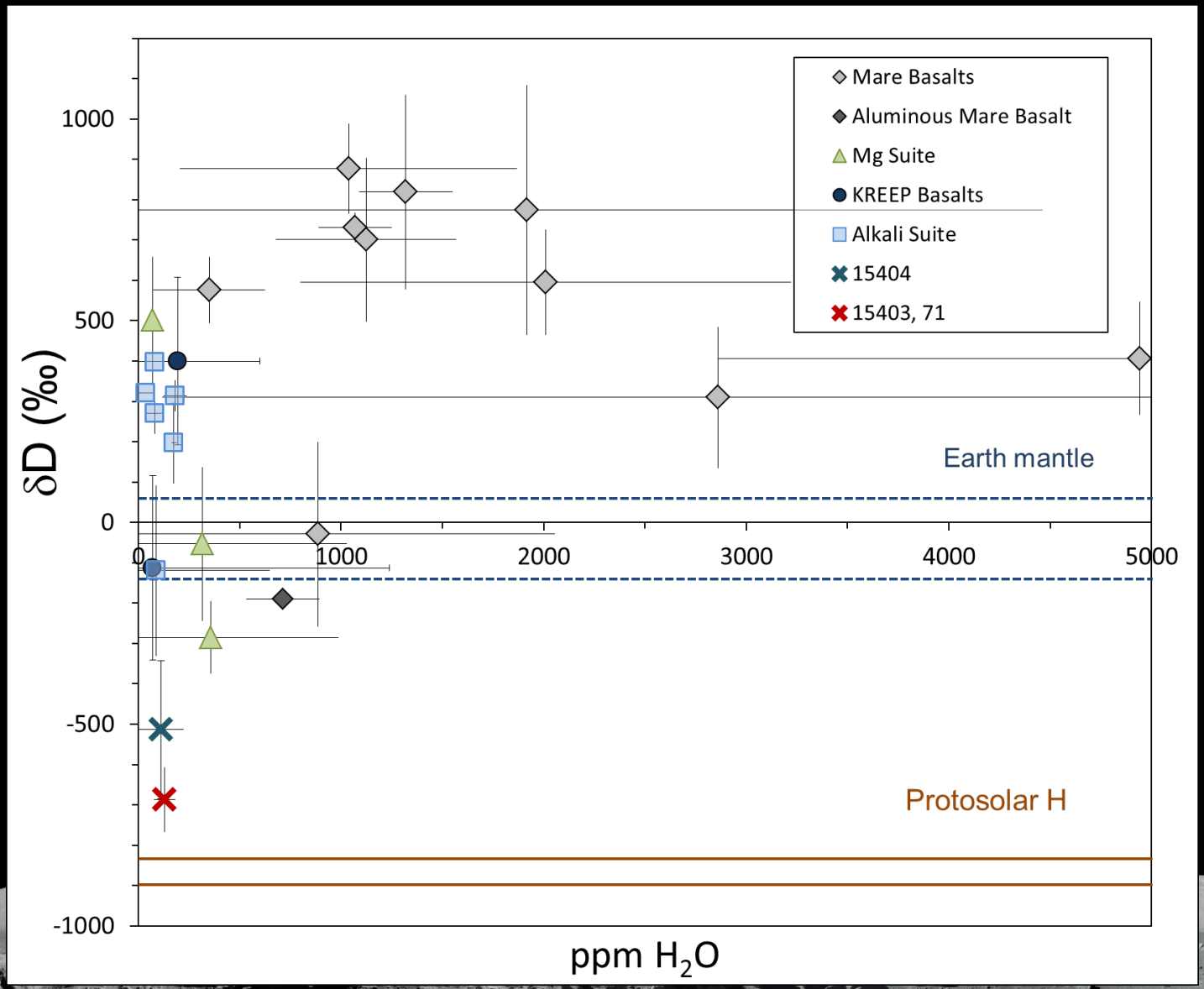
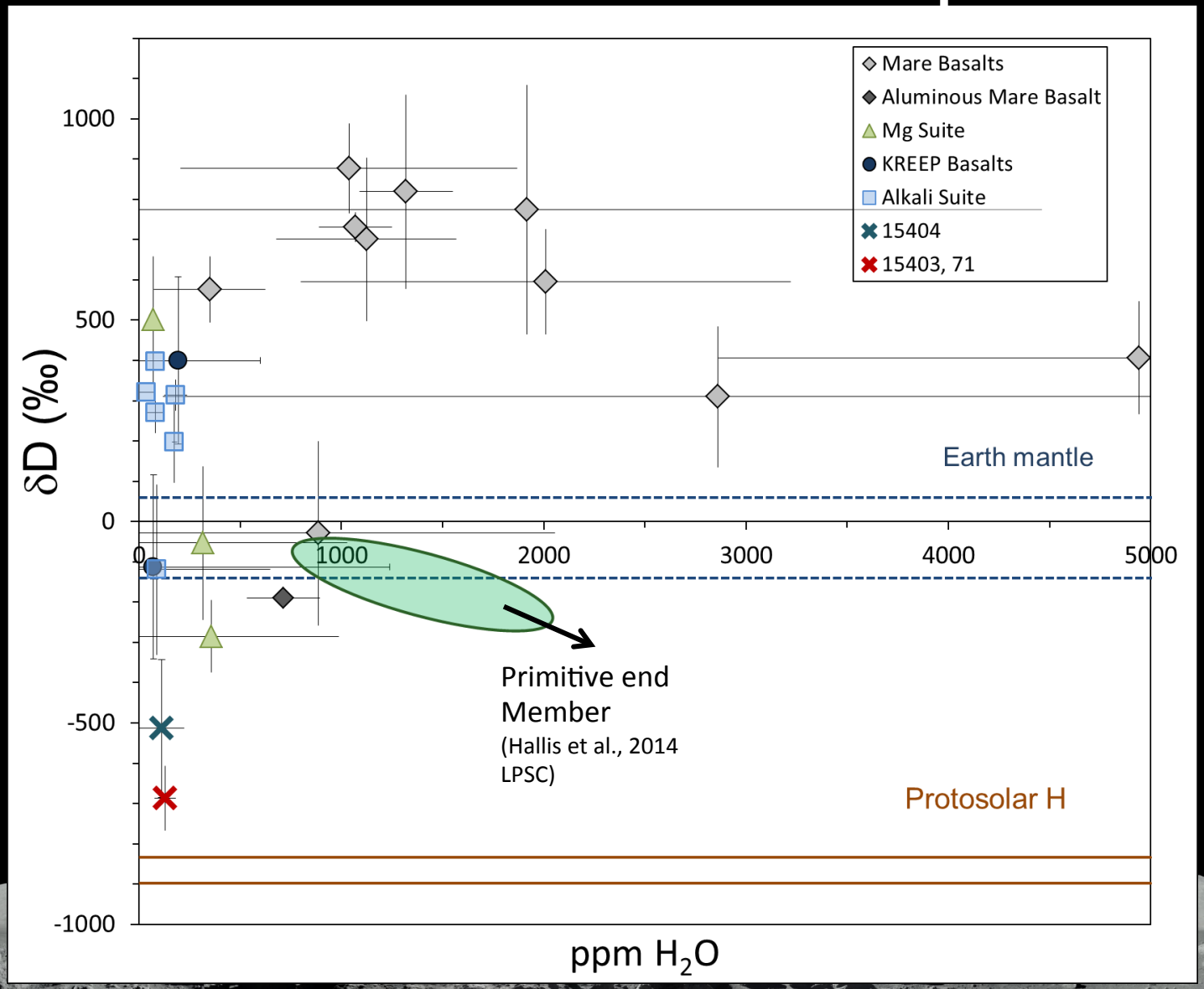


The low D/H component



Terrestrial Primitive Component



Conclusions

- Low δD in lunar interior could represent a primitive source, such protosolar H
- ***If*** this is a primitive component, it largely avoided fractionation during the Moon forming impact and lunar accretion
- There appear to be several reservoirs in the lunar interior based on δD and H_2O content

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