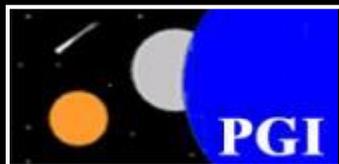




“THE NEED FOR CORPORATE MEMORY”



**Larry Taylor
Planetary Sciences Institute
Earth and Planetary Sciences
The University of Tennessee**



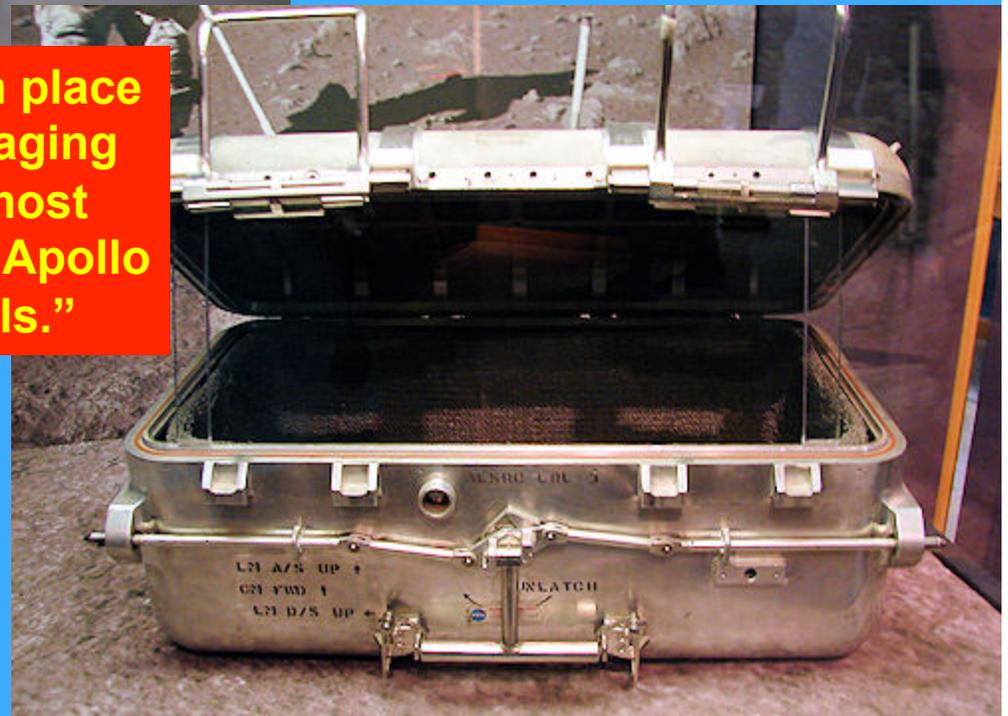


One of the proud accomplishments in ORNL history was to develop and manufacture "moon boxes" for the historic Apollo 11 mission in July 1969.which had a metalized gasket that firmly sealed when closed." Metal straps secured the lid while in transit.

BUT, they all leaked, several to one atm Houston.



Nine scoops of lunar soil were used in place of the unavailable 'popcorn' for packaging Apollo 11 rocks! This became the most studied lunar soil, 10084. Much of the Apollo soils were simply "packing materials."

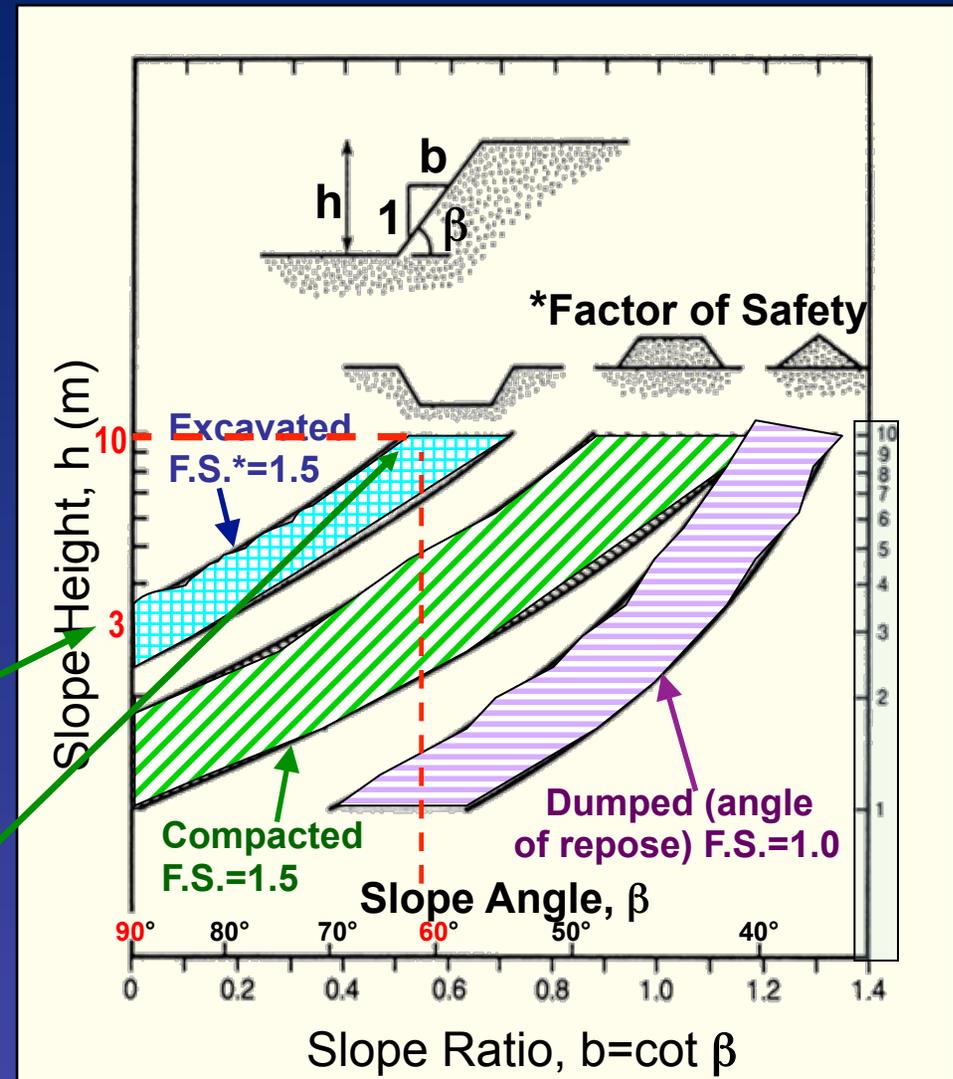


Slope Stability (Fig. 9.39; LSB, 1991)

Calculated stability of artificial slopes constructed in lunar surface material. Data are presented for 3 situations:

- (1) an excavation in lunar soil
- (2) a compacted pile of excavated lunar soil;
- (3) a dumped pile of lunar soil

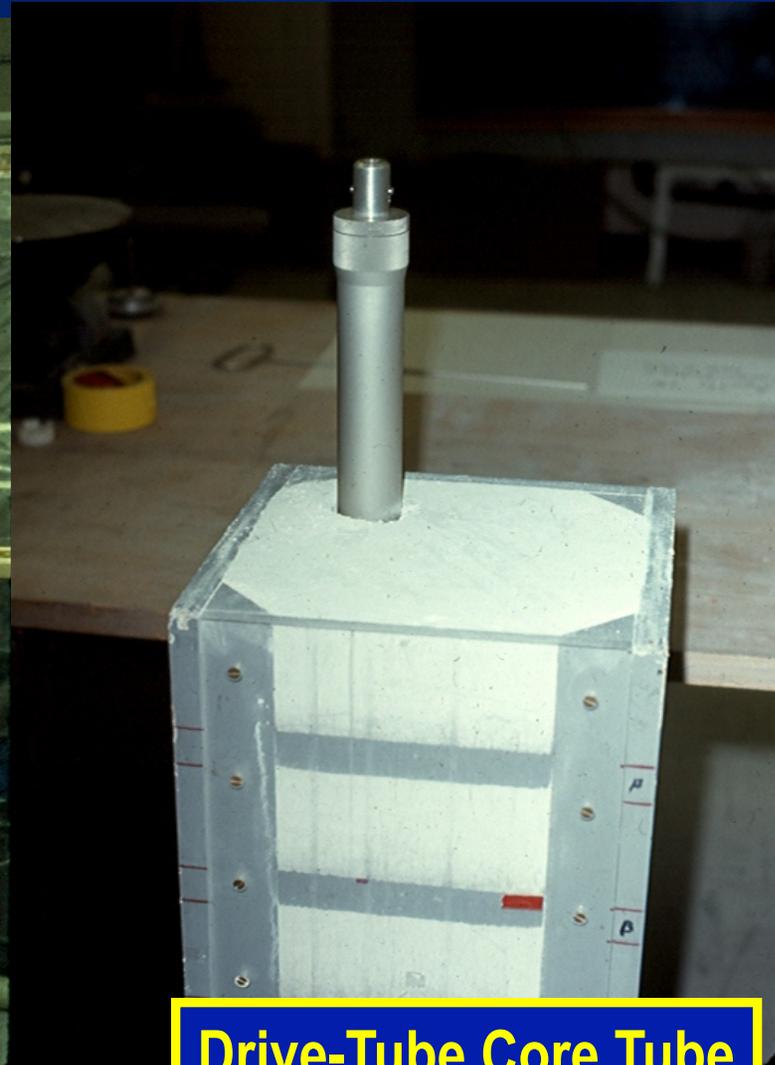
A vertical cut can safely be made in lunar soil to a depth of about 3 m;
an excavated slope of 60° can be maintained to a depth of about 10 m.





LUNAR SOIL TEST BED

**Kaolinite Clay
+
League City Sand
(With C-Black Markers)**



Don Burnett's Neutron-Flux Experiment



Duplicate Packing of Lunar Simulant is commonly not considered for Excavation and Drilling Experiments

Hammering of 1 meter spike into properly packed "lunar soil" was not possible!





STRAWMAN LIST OF SIMULANTS NEEDED FOR STUDIES OF:

	<u>Chemistry</u>	<u>Geotech/Engr</u>	<u>Simulant</u>
Facilities Construction		XX	JSC-1A; MLS-2
Regolith Digging and Movin		XX	JSC-1A; MLS-2
Trafficability (e.g., Roads)	XX	XX	JSC-1A; MLS-2
Microwave Processing	X	X	NP-1; JSC-1A; MLS-2
Conventional Heat Treatment	X	X	JSC-1A; MLS-2
Oxygen Production	X	X	JSC-1A; MLS-1;MLS-2
Dust Abatement + Tribology	X	X	NP-1; JSC-1A
Mineral Beneficiation	X	X	???
Solar-Wind Gas Release	XX	X	JSC-1A; MLS-2; NP-1
Cement Manufacture	X		JSC-1A; MLS-2
Radiation Protection		X	JSC-1A; MLS-1;
Biology - Toxicity	X	X	MLS-2
			ONLY Apollo Soils

Mare Soil: JSC-1A = JSC-1 in chemistry + Geotech Prop.
 MLS-1 = Chemistry only of Apollo 11 soil (no glass)
Highland Soil: MLS-2 = Anorthosite = Chemistry only
Magnetic Soil: NP-1 = Nanophase Magnetic properties only

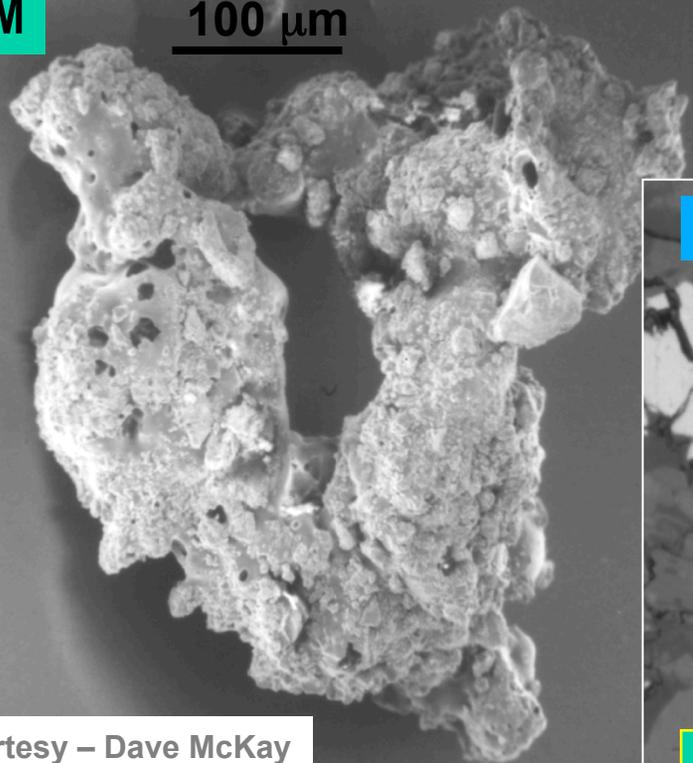
Concern for the Apollo lunar samples led the Planetary Science Subcommittee [PSS] of the NASA Advisory Council [NAC] to recommend

"that a comprehensive study be undertaken by LEAG and CAPTEM to define the types of lunar simulants that the various communities require in order to facilitate important lunar investigations, as well as to preserve the Apollo lunar sample collection for future generations."

**Many simulants needed!
ONE SIZE DOES NOT FIT ALL**

SEM

100 μm



Courtesy – Dave McKay

Mare-Soil Agglutinates

Ilmenite

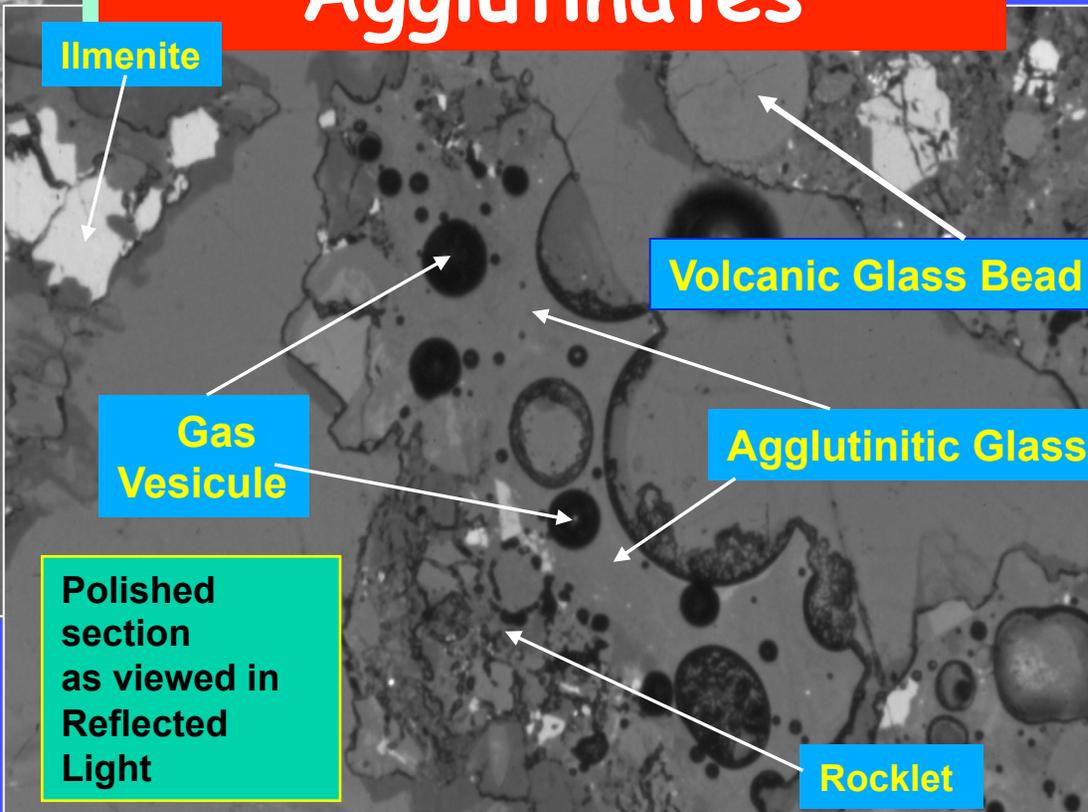
Volcanic Glass Bead

Gas Vesicule

Agglutinitic Glass

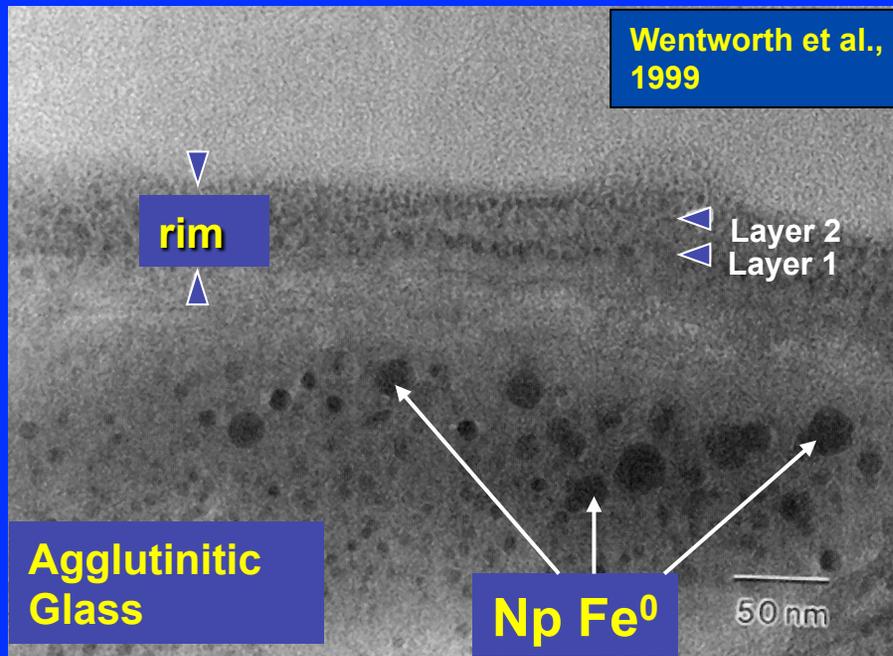
Polished section as viewed in Reflected Light

Rocklet

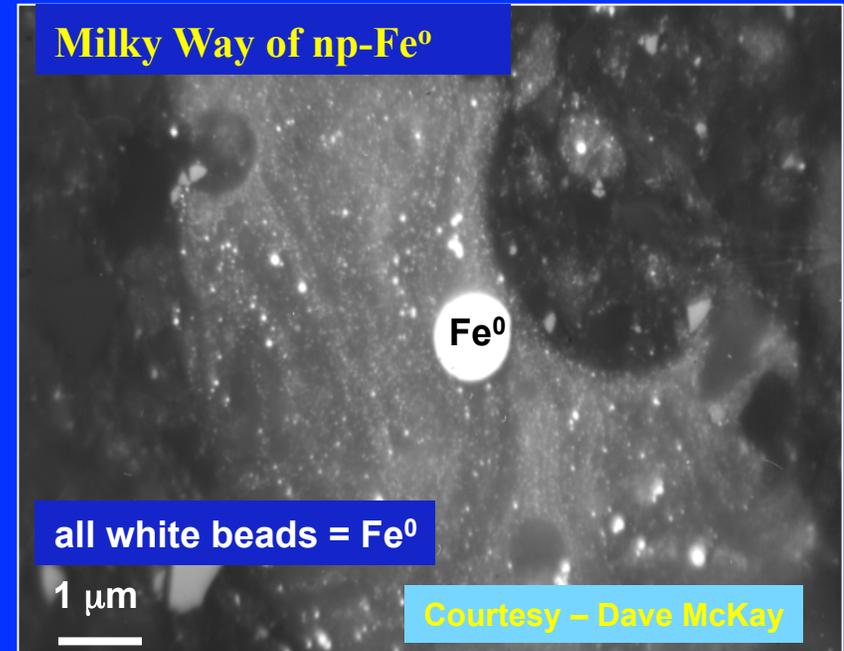


Pieces of minerals, rocklets, and glass welded together by shock-melt glass

Single Domain Fe 3-33 nm BECOMES
Nanophase Fe = <1000 nm = <1 μm;
Even Sub-Micron Fe = SM Fe



TEM Image of Glass Rim



SEM BSE-Image of Mare Agglutinitic Glass

**All White Specks are
Nanophase Ti-Magnetite**

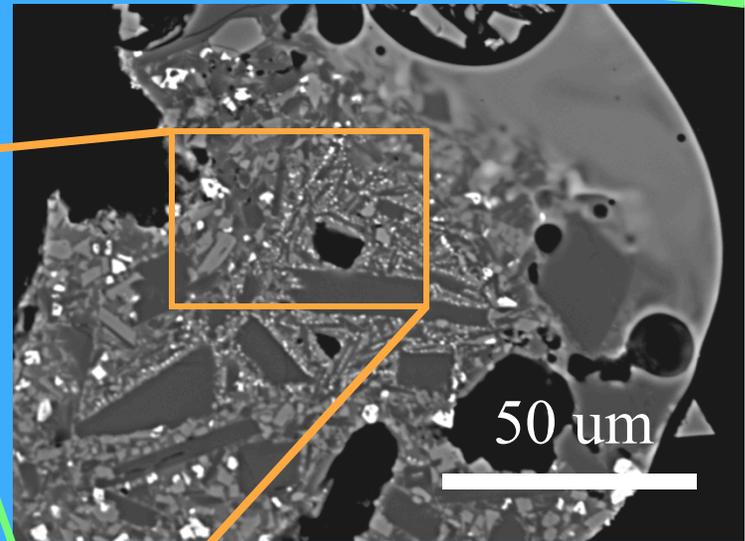
SEM - BSE

500 μm

**ORBITEC
JSC-1A NP-Fe**

**Magnetic & Dielectric
properties are from
Magnetite**

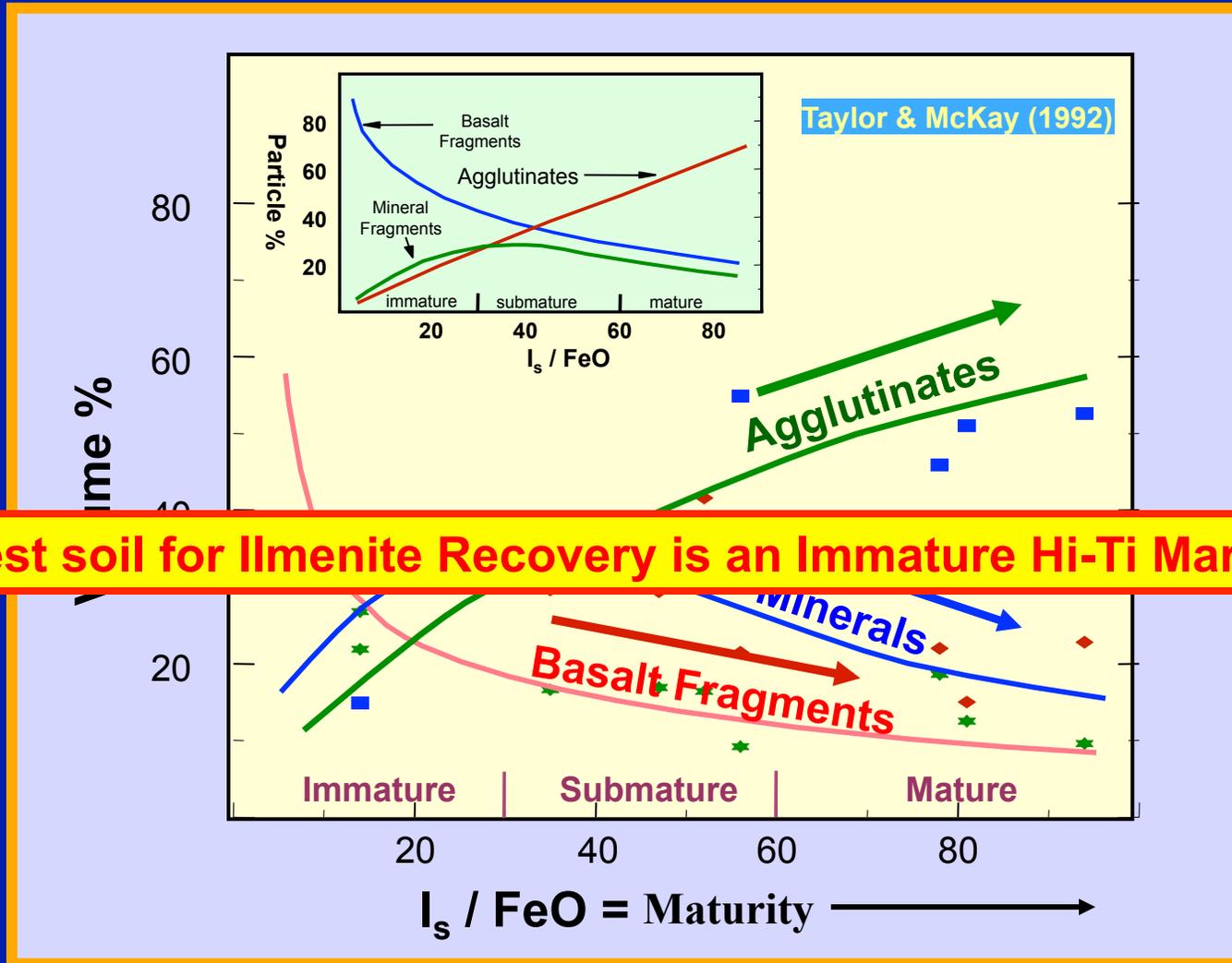
20 μm



50 μm

**Nanophase Fe =
3-33 nm ONLY!**

Mare Soil Maturation

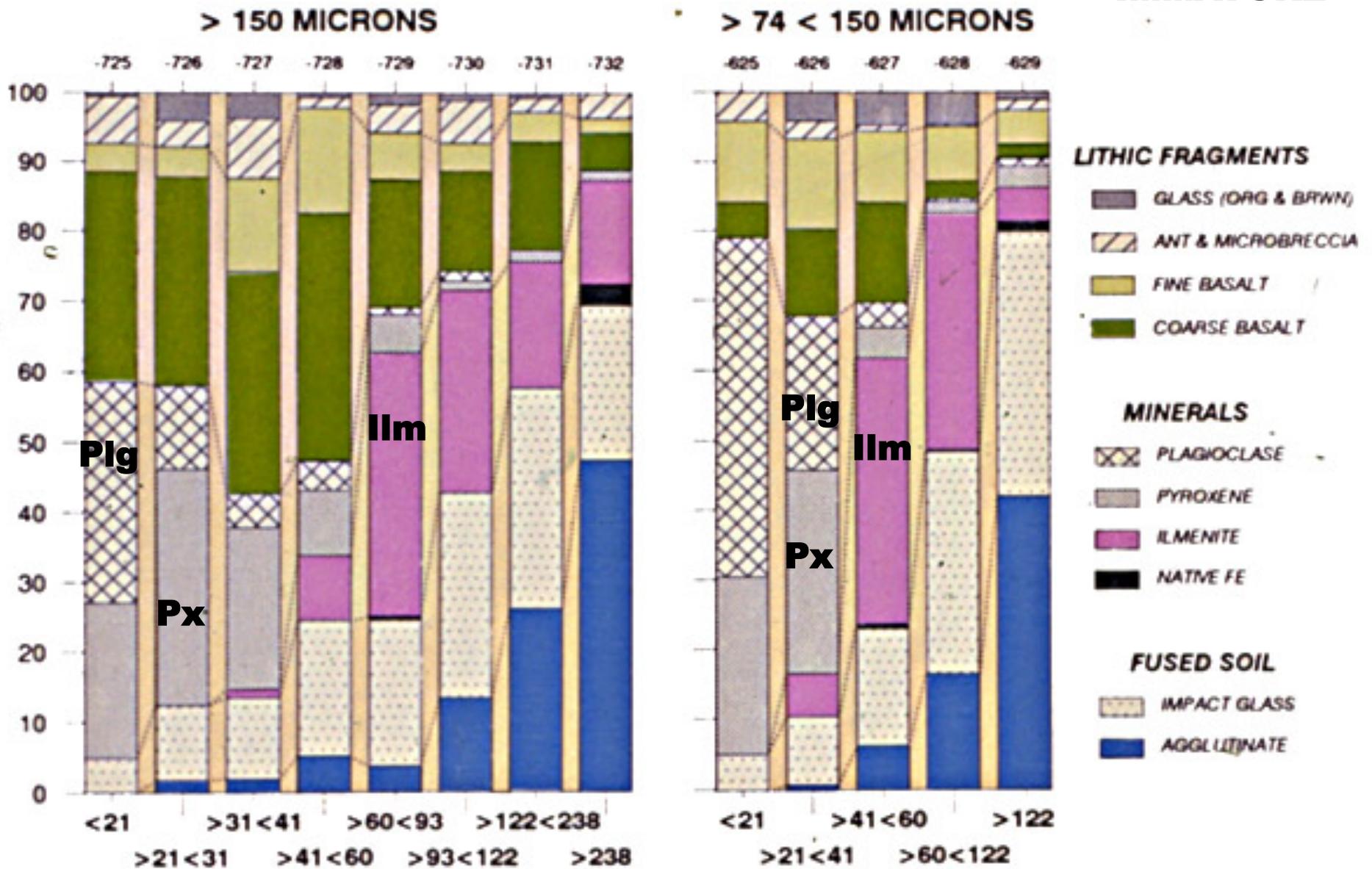


The best soil for Ilmenite Recovery is an Immature Hi-Ti Mare Soil.

EXPOSURE AGE →

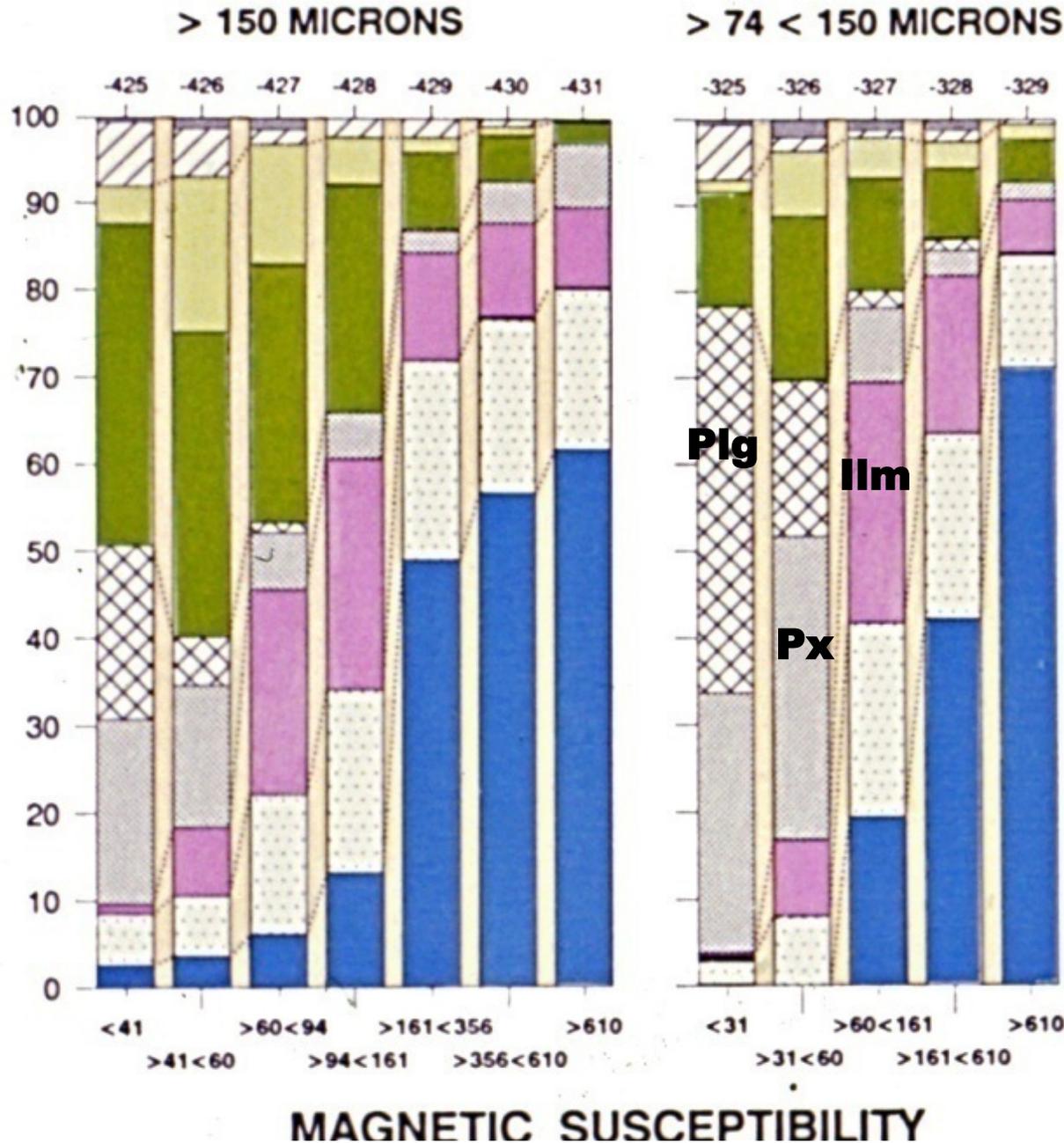
LUNAR SOIL 71061,233

**Is/FeO = 14
IMMATURE**



LUNAR SOIL 71501,234

**Is/FeO = 35
SUBMATURE**



Taylor & Oder (1990)



Summary



Rock Boxes all Leaked!



Compaction of Lunar Simulants NOT like In-Situ Lunar Soil;



MOST Lunar Soil Simulants NOT Adequate for ISRU Studies;



Lunar Simulants for Single-Domain Fe Studies NOT Adequate OR Necessary;



Lunar Minerals NOT Similar to Those on Earth; No Fe 3+.

MAKE APOLLO SOILS MORE ACCESSABLE FOR ISRU RESEARCH!!

Courtesy of
the Tennessee
Bible Belt

