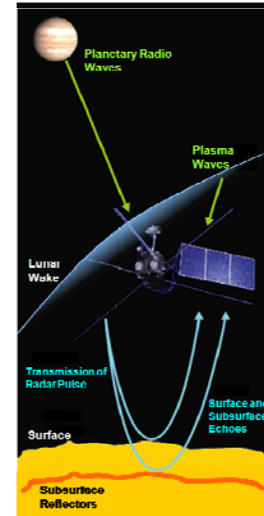


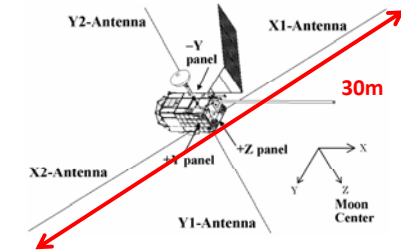
かぐや月レーダサウンダによる 月地下構造・自然電波の観測

熊本篤志, 小野高幸, 山口靖, 山路敦,
小林敬生, 押上祥子, 笠原禎也

Lunar Radar Sounder (LRS)



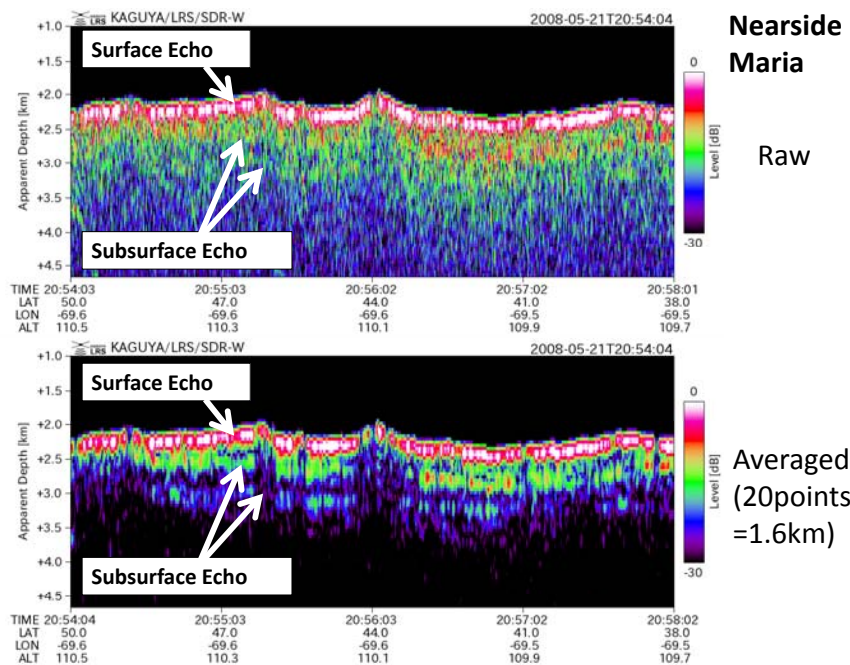
KAGUYA/LRS(2007-2009)
[Ono et al., 2010]



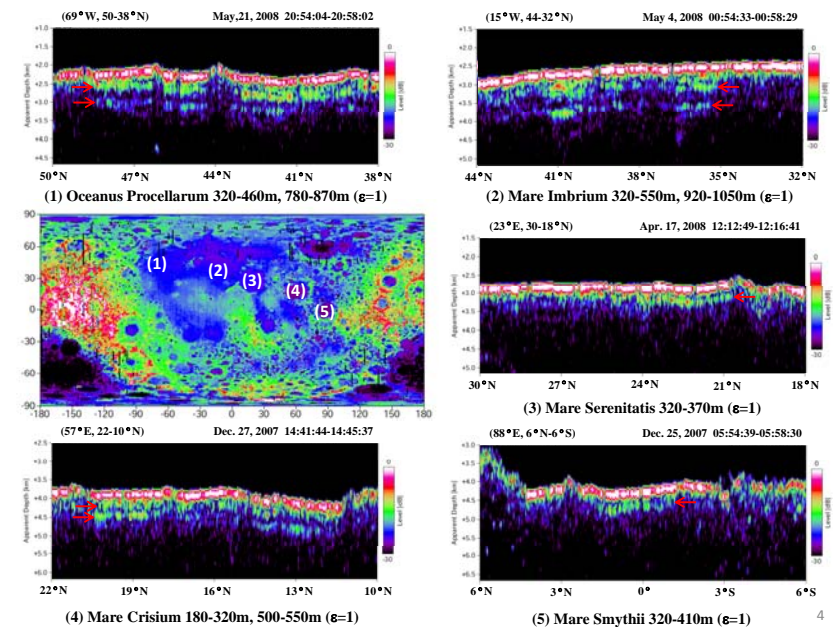
The first lunar global subsurface radar sounding (SDR)
Frequency: 5 ± 1 MHz (FMCW)
Transmission power: 800W
Range resolution: 75m

The first plasma wave observation within an altitude of 100 km around the Moon(WFC)
Frequency: 10 Hz – 1 MHz
Spectrum and waveform

Natural/artificial radio wave monitor from the Moon (NPW)
Frequency: 20 kHz – 30 MHz
Spectrum and waveform



Reflectors are found in several nearside maria [Ono et al., 2009]

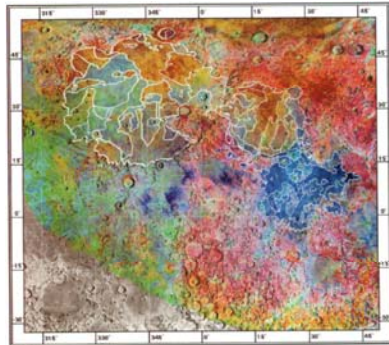


Subsurface reflectors in the nearside maria

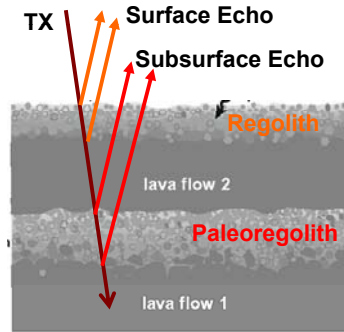
- High reflectivity (High ϵ contrast)
- Regolith ($\epsilon \sim 4$) and Lava ($\epsilon \sim 8$)
- Almost horizontal
- Surface of the low viscosity lava

Buried Paleoregolith

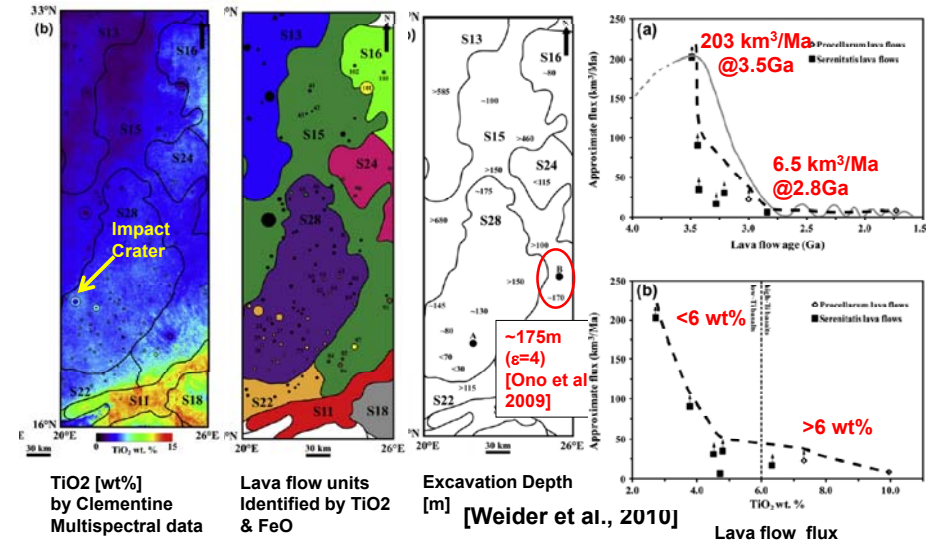
- Deformation due to cooling → Lunar thermal history
- Evolution of lava flow flux → Lunar volcanic history
- Record of ancient solar wind → Evolution of Sun and solar system



Galileo SSI multispectral images [Hiesinger et al., 2000]

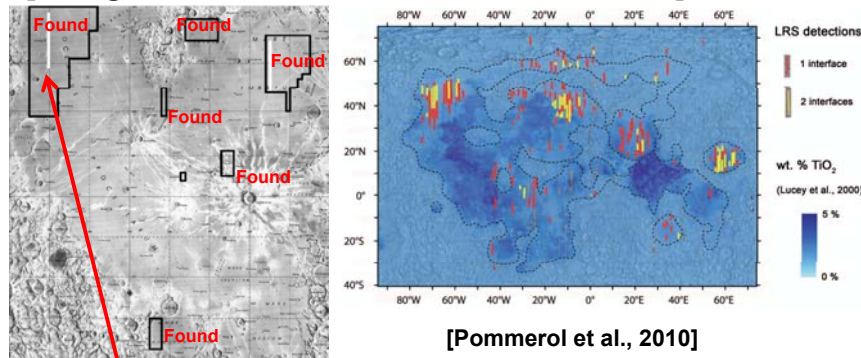


Impact craters → Lava flow unit thickness



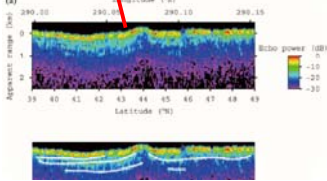
Kaguya地形・分光カメラ&LRS→より確度の高い議論が可能 (名大グループで解析進行中/山口&押上, Private communication)

Inhomogeneity of clear subsurface reflectors [Oshigami et al., 2009; Pommerol et al., 2010]



[Pommerol et al., 2010]

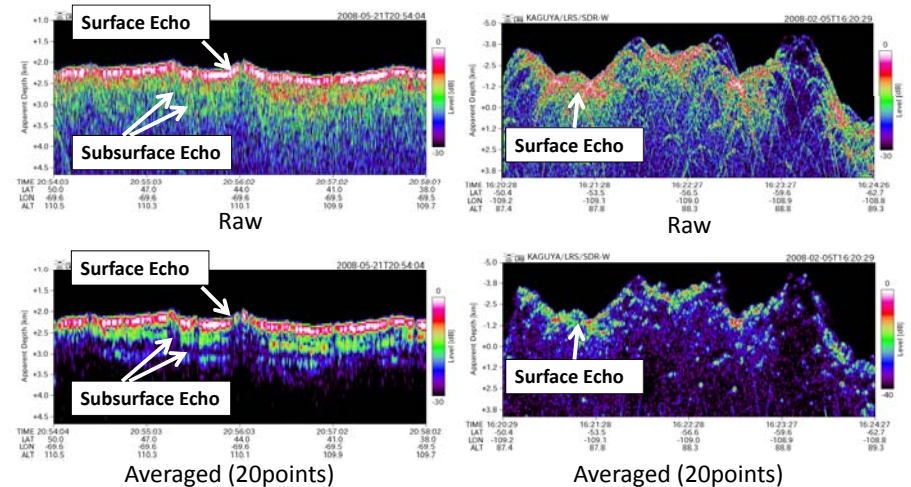
- Clear subsurface reflectors are found only in 10% of the nearside maria region.
- Old surface region (Thick buried regolith?) [Oshigami et al., 2009]
- TiO₂-poor region (Less echo power loss?) [Pommerol et al., 2010]



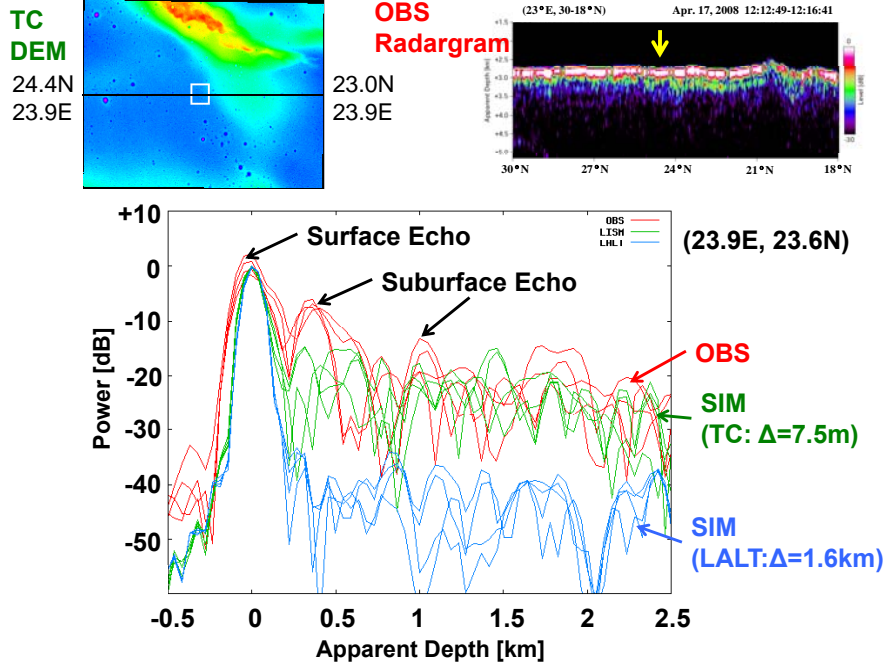
[Oshigami et al., 2009]

Nearside Maria

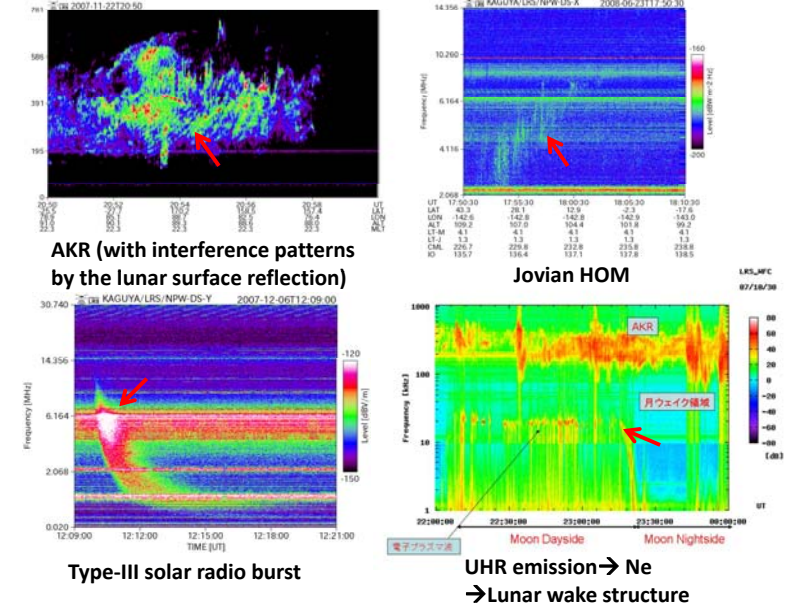
Farside Highland



How can we identify subsurface echoes not only in Maria but also in Highland?



Radio wave observations (NPW,WFC)

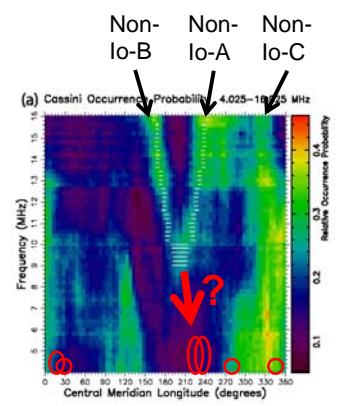


Jovian HOM

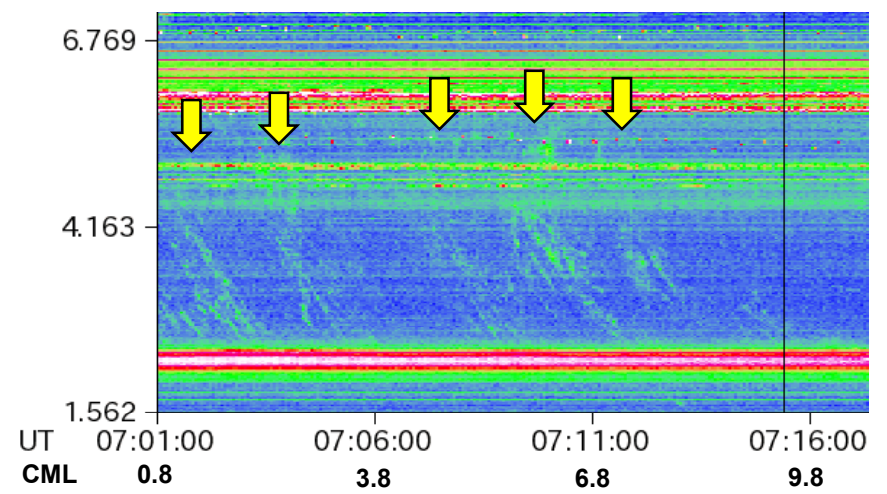
地球電離圏で反射 \rightarrow 地上観測不可
 テレメトリ容量の制約 \rightarrow 高分解能観測難

確認されたイベント
 DAM: 0例
 HOM: 6例

#	Date	Time	CML	Remark		
1	2008-05-28	00:30-00:50	2-11	Non-lo-C	2-4	DS
2	2008-06-23	17:50-18:00	226-233	Non-lo-A?	2-6	DS
3	2008-07-18	07:00-07:15	1-10	Non-lo-C	2-5	W
4	2008-08-07	12:55-13:05	347-353	Non-lo-C	2-4	W
5	2008-08-22	17:00-17:15	234-243	Non-lo-A?	1-6	DS
6	2008-08-31	20:20-20:25	270-272	Non-lo-C	1-4	W



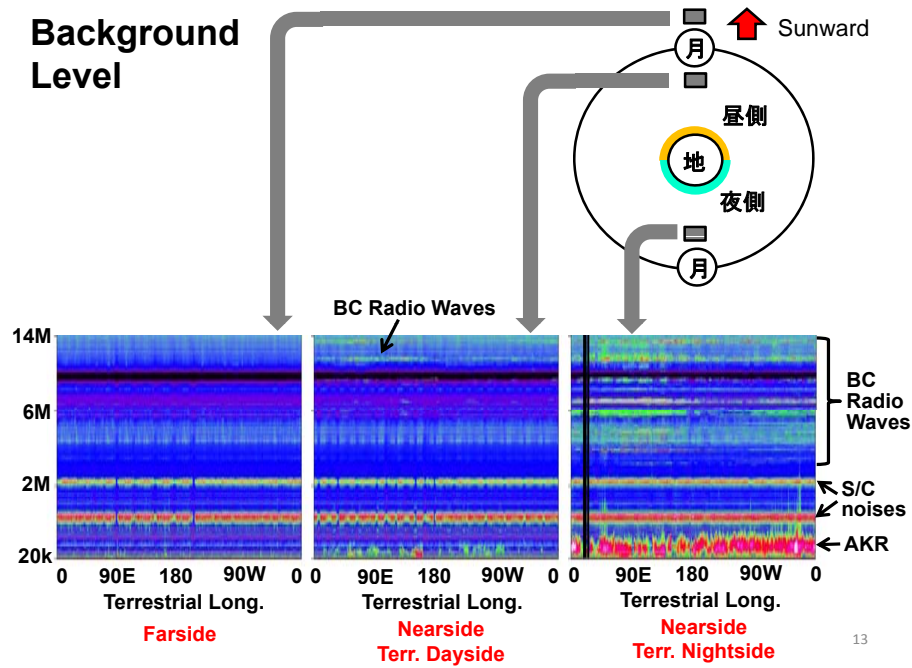
Non-lo-DAM/HOM出現頻度 (Cassini)[Imai et al., 2008]



時間分解能: 100msec

Arc structures
 $1\text{MHz}/\text{min}(=0.25R_j/\text{min}) \rightarrow (\text{Cone Angle})@(\text{Source locations})$

Background Level



Summary

1. Nearside Maria

- Subsurface reflectors at depths of several hundred meters [Ono et al., 2009]
 - Buried paleogeograph
- Comparison with multispectral imager [c.f. Weider et al., 2010]
 - Thickness of lava flow unit → Evolution of lava flow flux
 - Electric permittivity model

2. Other regions (Farside Highland, Polar region, Around crater)

- Comparison with surface echo simulation using DEM by TC (resolution: 7.5m)

3. Jovian HOM

- 6 events are found.
- Arc structures → Source locations/Cone half angle

4. Background level

- Farside: Quiet
- Nearside: Almost quiet (Earth's dayside), Noisy (Earth's nightside)