Lunar Resources

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I. Introduction and summary of topic from New Views I **[Crawford, Anand; 500 words]**

II. Resources of the Moon

A. Materials and energy **[Crawford, Cowley, others?; 1500 words]**

1. Update geological background (all elements are present on Moon, but concentrations vary widely **[Crawford, Anand, Spudis?]**
2. Power availability (photovoltaics, solar furnaces, night-time energy storage, nuclear power, fuel cells, etc) **[Cowley; anyone else?]**

B. Lunar volatiles [**Anand to coordinate with contributions from: Barber, Carpenter, Flahaut, Gaddis, Greenhagen, Gruener, Haruyama, Hurley, Sanders, Sefton-Nash, Spudis, Taylor, et al; 5000 words]**

1. Importance of lunar volatiles as resources **[Anand et al]**
2. Polar (permanently shadowed) volatile deposits (water plus other volatiles and organics) **[Anand et al]**
3. Non-permanently shadowed volatiles (e.g. evidence of high-latitude hydrated regolith – is it a potential resource?) **[Barber ?]**
4. Pyroclastic and other magmatic sources of volatiles **[Gaddis, Anand]**
5. Solar wind-implanted volatiles **[Fa, Taylor?]**

C. Oxygen from silicate materials **[Morse, Sanders?, Sargeant, Taylor; 1200 words]**

1. Summarize importance of extracting oxygen from silicate materials as a non-polar alternative to utilizing lunar water
2. Summarize key oxygen production schemes (e.g. ilmenite reduction, magma electrolysis, etc), concentrating developments since NVM I.

D. Metals and other common elements **[Tartese, Morse, Sanders?, Taylor? Van Westrenen?; 1200 words]**

1. Fe, Al, Ti as residuum from oxygen production processes **[Morse, Sargeant, Sanders? Taylor?]**
2. Metallic ores/deposits resulting from lunar magmatic processes (e.g. Cu could be especially useful as an electrical conductor) **[Tartese]**
3. Silicon (e.g as local source for photovoltaics) **[Tartese? Sanders? Van Westrenen?]**

E. Rare-Earth (and related) elements **[McLeod; others TBD; 1200 words]**

1. Assessment of REE enhancements in KREEP-rich areas
2. Assessment of lunar U and Th concentrations and applicability to *in situ* nuclear power generation

F. Materials from asteroidal and meteoritic sources **[Crawford,** Anand; 500 words**]**

1. Fe and siderophile elements from iron meteorites
2. Carbon, Nitrogen, organics, and volatiles from carbonaceous meteorites

G. Bulk regolith as a resource **[Cowley, Greenhagen, Morse; 1200 words]**

1. Possible use for: berms, backfill, landing pads, roads, ceramics, radiation shielding
2. Properties from a resource perspective (grain sizes, cohesiveness, trafficability)
3. Processing bulk regolith (packing, microwave and solar thermal sintering, ceramic manufacture

H. The lunar environment as a resource **[Haruyama, Flahaut, , Greenhagen, Morse, Sefton-Nash; 1200 words]**

1. Quasi-permanent sunlight (locations, durations, etc) **[Flahaut?]**
2. Permanent shadowed regions as a resource (e.g, stable, extreme cold)
3. Vacuum as a resource
4. Lava tubes and other natural shelters **[Morse, Haruyama]**

III. Lunar Resource Information Gathering Strategy **[Neal, Anand, Barber, Crawford, Carpenter, Barber, Flahaut, Greenhagen, Gruener, Klaus, McLeod, Morse, Sefton-Nash, Spudis, et al; 1500 words]**

A. Data in hand vs. data needs – know presence, but not the details. Knowledge gaps **[Neal]**
B. Orbital data – bistatic radar imaging, active neutron sensing, high-resolution near to mid-IR spectroscopy, high-resolution X-ray fluorescence spectroscopy **[Spudis, Neal, others]**
C. Hard and crash landers/penetrators – point measurements **[Barber, Morse]**
D. Fixed station landers – point data, long-lived monitoring, drilling **[Carpenter, Barber, Morse]**
E. Rovers and hoppers – mobile platforms, instruments, transects and profiles
F. Synergies with human exploration **[Crawford, Spudis, Klaus, others?]**
G. Decision points – how much prospecting data is enough? **[Neal, Spudis, others?]**

IV. International and legal context **[Crawford, Barber, others?]**