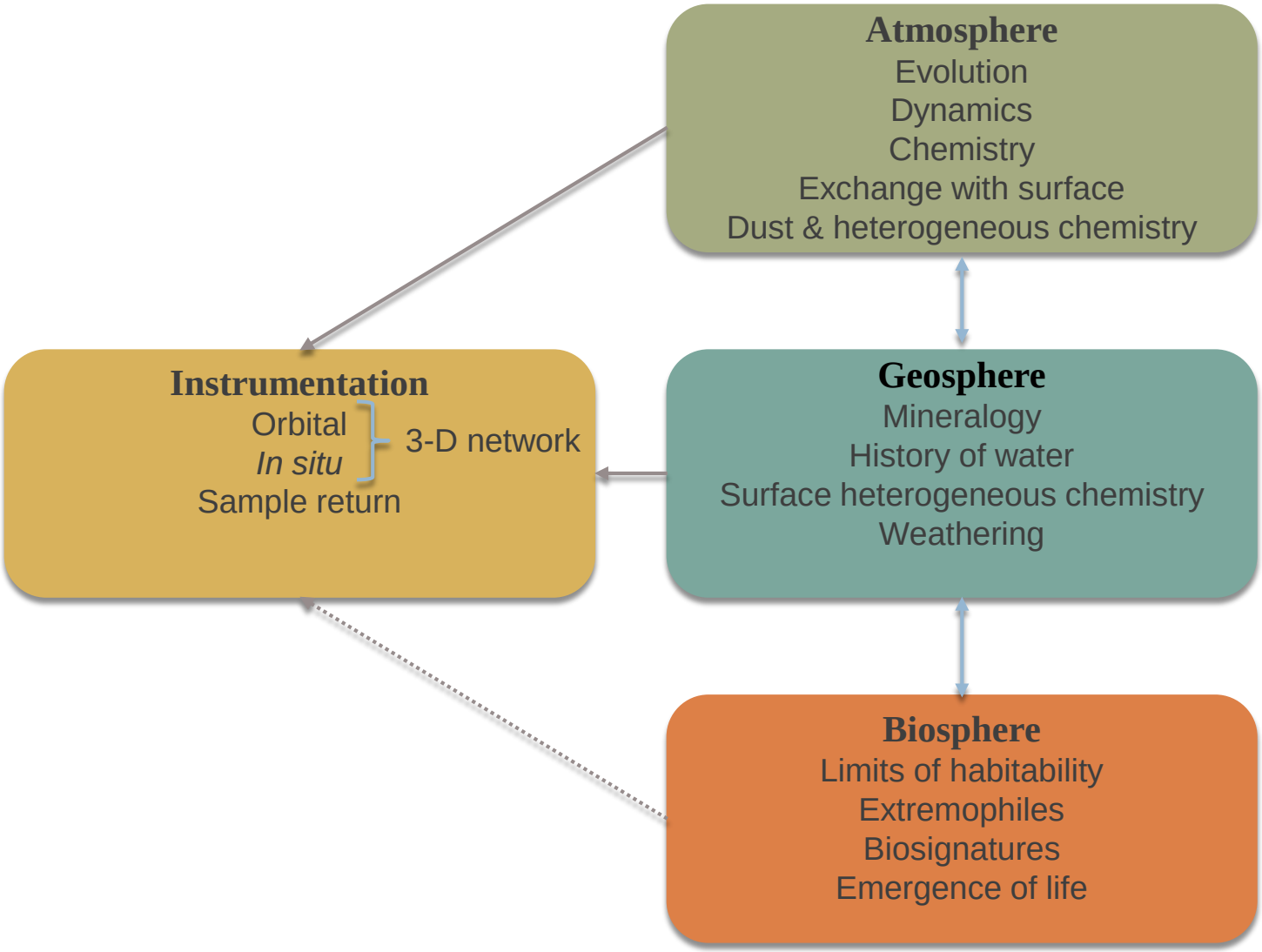
Habitability of Mars



Interim-Group Reports

- **Potential Scenarios of ExoMars Findings:** Michael Wong
- **Earth-Analog Exploration & Laboratory Investigations:** Charles Miller
- **Seepage:** Giuseppe Etiope
- **Near Surface & Surface Sinks & Sources:** Michael Mischna
- **Dust and Heterogeneous Chemistry - The Multi-phase Problem:** Yuk Yung
- **Coupled Geodynamical-Geochemical Modeling:** Vlada Stamenkovic
- **Technology:** Armin Kleinboehl

Informal talks to get us in the thinking mode about these topics

Please consult the Workshop agenda!

Methane on Mars

What about the methane?

- How much methane is produced?
- Where is it produced?
  (subsurface, surface, atmosphere?)
- How is it produced?
  (geologically, biologically, other?)
- When is it produced?
- How is it distributed?

Methane on Mars: In Search of Habitability

- By looking at methane as the central issue, we are necessarily connected to other questions, other elements, and the quest for an in-depth understanding of Mars geology and potential biology.
- The excitement of methane lies in understanding the dynamics of Mars' geology and elemental cycles, and of the potential connection to life, either extant or extinct.
- Leads us to the question of whether there could be extant life on Mars, and/or whether there was ever life on the Red Planet.

Methane on Mars: In search of Habitability

- It also forces us to build an exploration strategy in which knowledge is gathered in a systematic way, with each discovery or set of discoveries leading to more knowledge on the road to understanding Mars and its potential habitability.
- In this context, we can, and should, consider a number of issues:
- To this end, we have focused attention on a few questions for breakout groups to begin with.

Methane on Mars: In Search of Habitability

1. What are the key unknowns with regard to methane production on Earth, and on Mars?
   - Biological
   - Geochemical
   - Exogenous (e.g. UV decomposition of IDP)

2. What modulates observed methane abundances in the atmosphere?
   - How is the global Mars meteorology expected to disperse and distribute any methane that is formed?
   - Sequestration and release cycles?
   - Heterogeneous reactions?

Methane on Mars: In Search of Habitability

3. What are the key unknowns that would drive the search for life forward in the Mars program? (not only for methane production or consumption, but life in general).

- Subsurface physio-chemical conditions
- Existence/availability of organics on Mars (not sure if this is fundamentally important).
- Early Mars (ocean and lake) physio-chemical conditions
- What are other potential markers of biological or geological activities (past or present) on Mars?

4. Where are the key places to search for indicators of life/habitability.

- How do we identify environments on Mars that could have a supply of reductants (e.g. gas-water-rock reactions, high-T magmatic processes)?
- Locales of energy/material communication with subsurface (e.g. seepage)
- Locales with liquid water (e.g. RSL)

Methane on Mars: In Search of Habitability

5. What are the most likely tools (platforms) to be used for such a search?
6. What kinds of missions are envisioned, and in what order?
7. What is our "wish list" of things we would like to detect and quantify?
8. What technologies are available to answer such questions?
9. What new abilities (technologies) are needed?

Methane on Mars: In Search of Habitability

FOCUS ON VERY LARGE QUESTIONS !!

- What types of new data would be key drivers for the continued study of Mars, both in terms of it being an abode for future life, and in terms of it being formerly (or even presently) an abode for Martian life?
- Where does methane fit into this, and what is needed in terms of data to begin to decipher these connections?

Methane on Mars: In Search of Habitability

FOCUS ON THE SUBSURFACE !!

- What are the arguments that the subsurface of Mars could be a habitable place?
- What do we need to know to constrain these arguments?
- How to we access the subsurface of Mars?
- How do we know how deep we need to go into the subsurface?
- What kinds of life might we expect there?
- Again, what critical data would drive the development of technologies to answer such questions?