Day 1

1. Modelling of primary and secondary metallic particles

- Can we reconcile different approaches to model the IP response of metallic particles to create a unified, general model, and if so, how?
- How can we better incorporate effects of fluid and surface chemistry, anisotropy, and microscale geometry into models of the IP response of metallic particles?
- What potential benefits could multidisciplinary work bring to model the IP response of metallic particles? Could collaborations with geochemists, electro-chemists, and microfluidic experts open new avenues for innovation?
- Is it time to explore non-linear modeling approaches, given that metallic polarization is related to strong surface charging?
- How can we combine machine learning with traditional methods to improve both mathematical and conceptual modeling of the IP response of metallic particles?
- **Possible outcome**: (Part of a) review paper on mineral exploration
- **Moderators**: Matthias Bücker, Véronique Naudet, Philippe Leroy

2. Lab to field - upscaling

- This roundtable is meant to be broad, i.e. not focused on a specific application – it may be split into more specific questions on Day 2.
- How big does the signal need to be to seen it in the field?
- Can we discriminate different types of metallic minerals? Can we quantify mineral concentrations?
- Can we measure high frequency effects (100 Hz – 1000 Hz) in the field?
- Work at intermediate scales (tank experiment, columns): what upscaling issues are encountered?
- **Possible outcome**: Roadmap paper + define several distinct questions to be explored separately on Day 2.

- **Moderators**: Virginie Leroux, Fred Nguyen, Sara Johansson

3. Lab standardization with focus on sample holders

- Bring your sample holder !!!! (or the design!)
- What electrode materials?
- What sample holder materials can handle aggressive compounds?
- Best practices for modelling the effects of the sample holder.
- Vocabulary, units, scales
- **Possible outcome**: Guidelines, comparison paper, setup international round robin tests
- **Moderators**: Matthias Halisch, Dennis Kreith

4. Field data processing and inversion

- From raw data to inverted result: walk us through your processing steps
- Data processing and inversion strategies
- Which tools/software are available to process and invert IP data?
- How does monitoring (time-lapse) improve inversion results?
- Retrieving spectral information from TDIP and comparison to FDIP
- From non-open source to open source
- **Possible outcome**: Design a collective project to process and invert one dataset by different techniques - write a paper about this.
- **Moderators**: Thomas Günther, Line Madsen, Aris Nivorlis, Matteo Rossi

5. Effect of fluid conductivity variations and non-equilibrium on the IP signal

- How to best decouple the IP signal change related to fluid conductivity versus that which we are trying to measure?
- Some options to deal with it in the lab, but not always applicable in the field.
- Models exist, but they mostly do not consider non-equilibrium of the soil-water chemistry (ions with solid surface, equilibrium too slow).
- Of great importance in highly dynamic systems, such as lab setups, but also thawing permafrost or contaminated sites.
- Spatial and temporal resolution, transition stages
- Both the phase angle and imaginary conductivity are affected by the fluid conductivity, but differently. Do equivalent circuits help?
- **Possible outcome**: Methodology to remove its effect when we are not interested in the changes. Link with modelling (roundtable no. 1)?
- **Moderators**: Adrian Mellage, Flore Rembert, Cora Strobel

6. Beyond geophysical inversion: towards process-based inversion of IP data

- Joint modelling of (time-lapse) IP data with reactive transport is one way to tackle the ambiguity of the IP signal, while providing relevant parameters for further modelling (flow, transport, reactions)
- Inversion of permeability and formation factor from static IP data: existing field examples, suitable validation data and predictive performance
- Inspiration from recent developments in process-based inversion of time-lapse ERT data and stochastic methods (link to table no. 4).
- Need for suitable petrophysical relations and uncertainty of those (link to table no. 2). Breakthrough from micro-scale investigations?

- Reactive transport modelling can also be used to evaluate the utilization of a novel application of time-lapse IP, and possibly improve the geophysical inversion constrain time-lapse parameters
- **Possible outcome**: Collective project to design a petrophysical library (existing relations and their uncertainties), review paper on existing coupled approaches, roadmap paper on process-based inversion of time-lapse IP data and steps to get there
- **Moderators**: Léa Lévy, Daniel Ciraula, Adrian Mellage

On Day 1 we'll split some of the tables, based on the interest, and look for additional moderators. Let us know if you are interested!

At the end of Day 1 and based on the discussions, the moderators will decide the theme for new roundtables on Day 2 (continuing discussions, making it more specific, new ideas etc.), on top of the four pre-defined topics below.

Day 2

1. The IP signal of organic matter / compounds

- Relevant for waste, landfill, permafrost, peat, soils, agriculture etc.
- Electrical properties of different functional groups associated with OM
- Particulate OM vs. dissolved OM vs. separated phase OM (NAPL)
- How can we create experiments that isolate the IP signature of the above?
- Conceptual models. Can we explain the IP signal?
- There exist models for hydrocarbons (yet not a consensus), to what extent can they be applied to fresh organic matter?
- How many observations are there?
- **Possible outcome**: review of existing conceptual models, propose new conceptual models
- **Moderators**: Adrian Flores-Orozco, Angelos Almpanis, Adrian Mellage

2. IP for characterizing and monitoring contaminated sites

- All types of contaminants: biogeochemical hotspots below landfills, metallic particles and ions, free-phase NAPL, PFAS etc.
- Which of them have been mapped with IP in the field? Which of them could be mapped in the future, based on existing lab results? (link to roundtable no. 2 on Day 1)
- What are the most relevant complementary data to map or monitor contaminants? (link to roundtable no. 6 on Day 1)
- **Possible outcome**: clarify the signal level of different types of contaminants, review paper?
- **Moderators**: Adrian Flores-Orozco, Sara Johansson, Aris Nivorlis

3. IP in controlled-source EM

- High-frequency IP effect (> kHz)
- Is IP in EM the same phenomenon as IP in DC?
- When does it work? (what contexts)
- How much signal do we get?
- Uncertainties
- **Possible outcome**: to be defined
- **Moderators**: Thomas Günther, Line Madsen

4. Organization of the International IP community

- Use outcome from roundtables on Day 1
- Data and software sharing, best practices
- Modeling community
- Hardware
- **Possible outcome**: Public website on github, list of available open source software, data repositories, petrophysical library, list of open access papers, short courses or summer school, “continent coordinator/chapter”, quarterly meetings?
- **Moderators**: Charles Berubé, Torleif Dahlin, Tina Martin, Damien Jougnot, Matthias Bücker, Matthias Halisch