# Constraining the architecture of the USM

## – a basis for future exploration as a heat storage reservoir?

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## 1 Introduction and study site

The *Untere Süsswassermolasse* (**USM**) is a constituent of the Swiss Molasse Basin consisting of fluviatile-lacustrine sediments, mainly intercalating sandstone and mudstone bodies *(Keller et al, 1992)*. The USM could be suitable for Aquifer Thermal Energy Storage (**ATES**) projects such as the *Geospeicher Forsthaus* and understanding the USM architecture is necessary for this. The area north of Bern is the area of interest and investigated at different scales.


**Fig. 1**: Area of interest, (*swisstopo, 2023*)

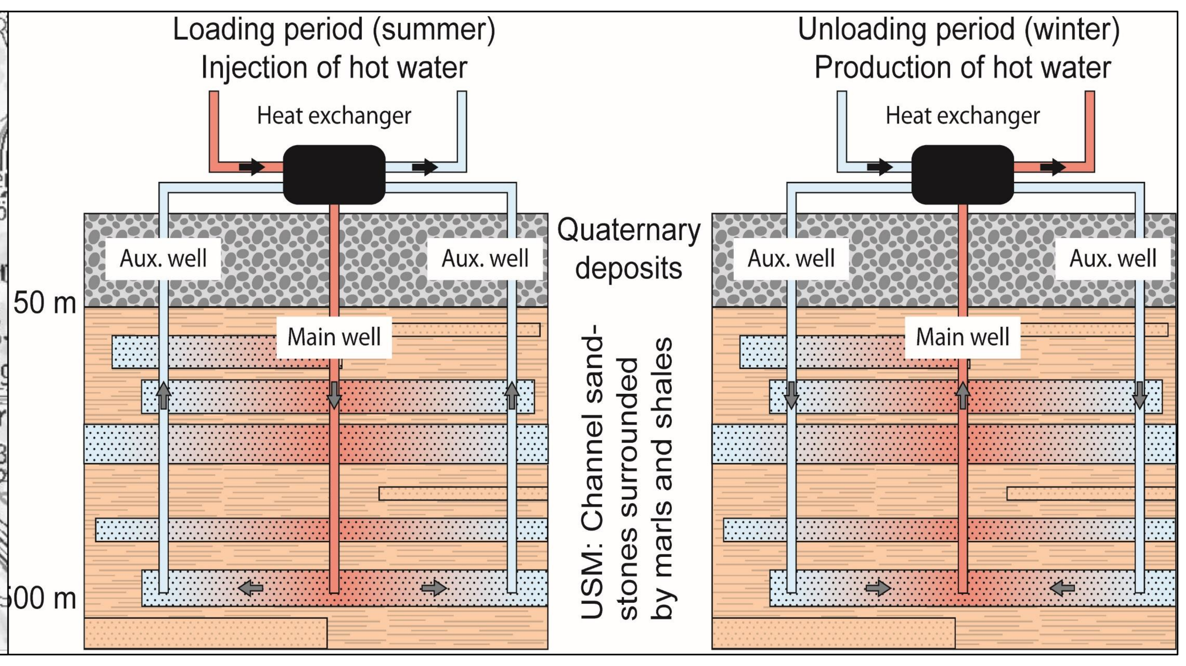


**Fig. 2**: Principle behind ATES. In summer, water from the aquifer is pumped up and heated and pumped down. In winter it is pumped up and used for heating.
(*van den Heuvel et al, 2021*)

## 2 Methods

Lithologic information from public well logs → MATLAB → Yields a 3D model → **allows analysis of spatial distribution of sandstone bodies**

Drone images from 2 clay pits and 2 natural outcrops → Agisoft → Yields a 3D model → **identification of sedimentary architectural elements possible**

Palaeosols from 2 clay pits → XRD, CNS, PSD → Yields mineralogical, chemical and grain size data → **identification of trends and possible correlation to sandstones**

## 3 Results of well log analysis

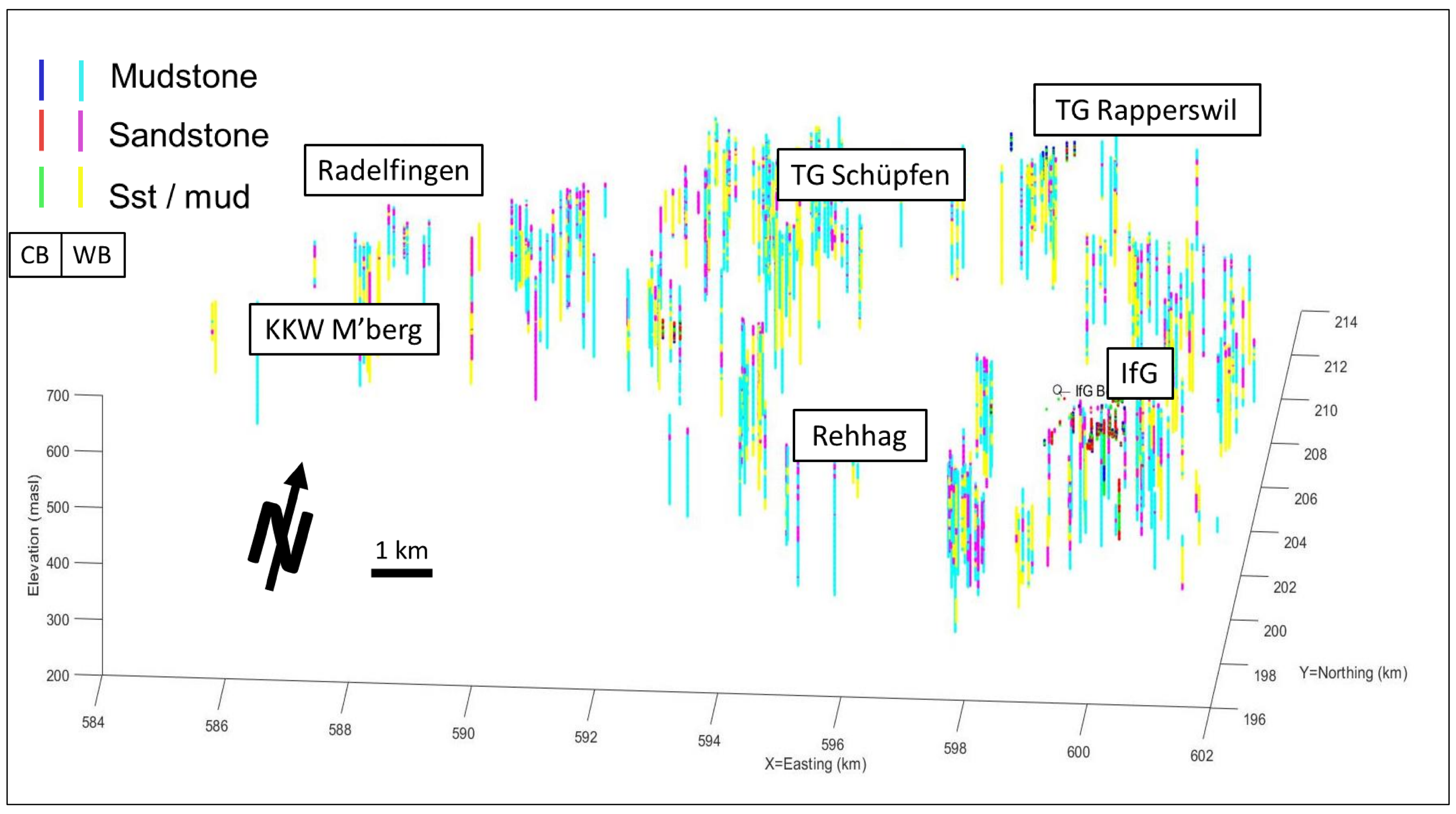


**Fig. 3**: 3D model of the USM in the region north of Bern

383 public well logs have been plotted and colour-coded. Sandstones are prevalent in some regions and mudstones in others.

**References**:
Keller, B., Bläsi, H.-R. and Platt, N., (1992), Technischer Bericht 90-41
Fig. 2: van den Heuvel, D.B., Alt-Epping, P., Richards, J.P., Wanner, C., and Diamond, L.W., (2021), Pre-study of the geological heat storage and utilisation project Geospeicher Forsthaus (Bern): Geological and geochemical aspects

## 4 Results of drone photo analysis

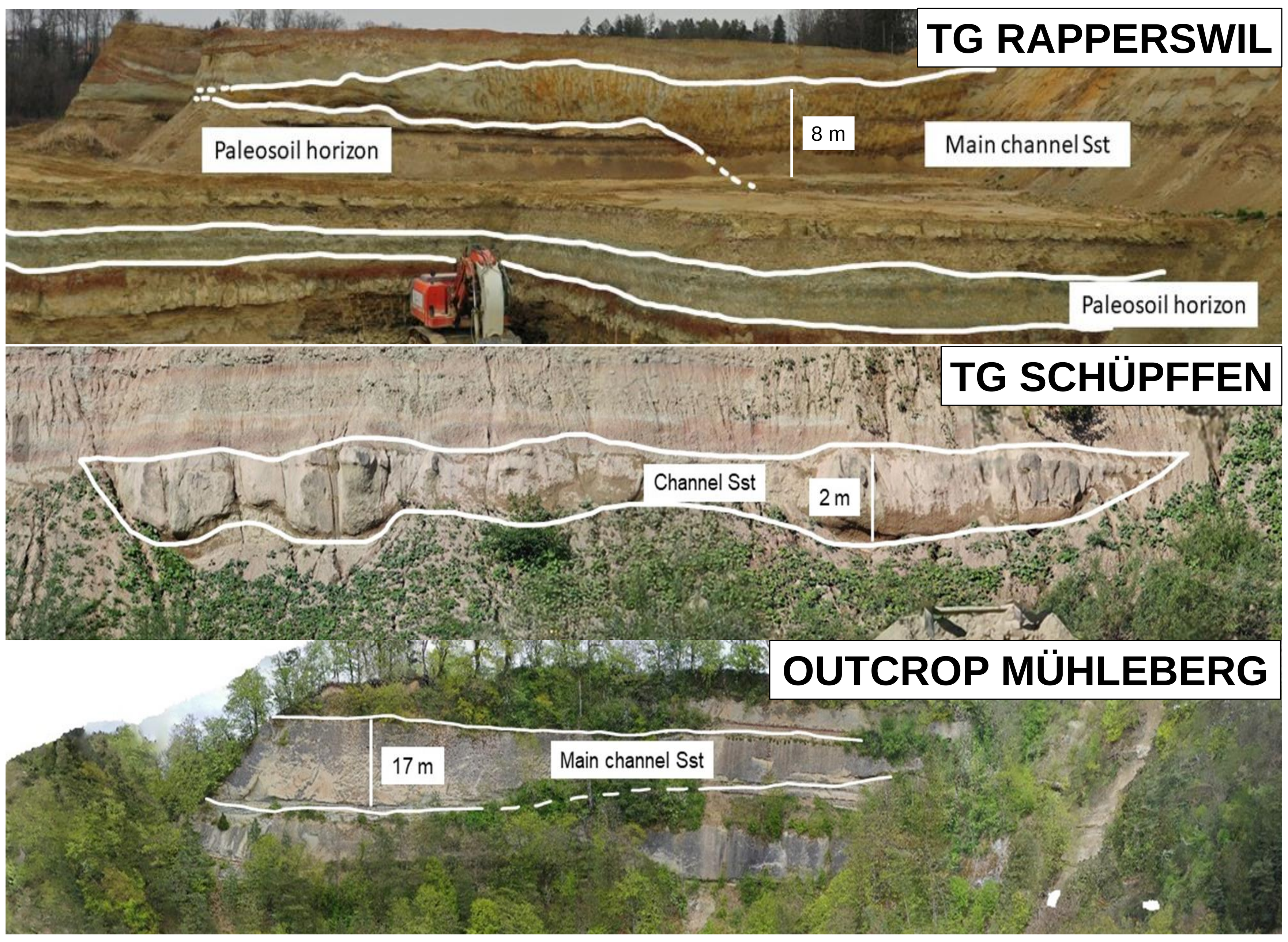


**Fig. 4**: Aerial drone images with architectural features visible

Close up view of sandstone bodies of varying sizes, envelopped by mudstones. Note extensive palaeosol horizon.

## 5 Results of palaeosol analysis

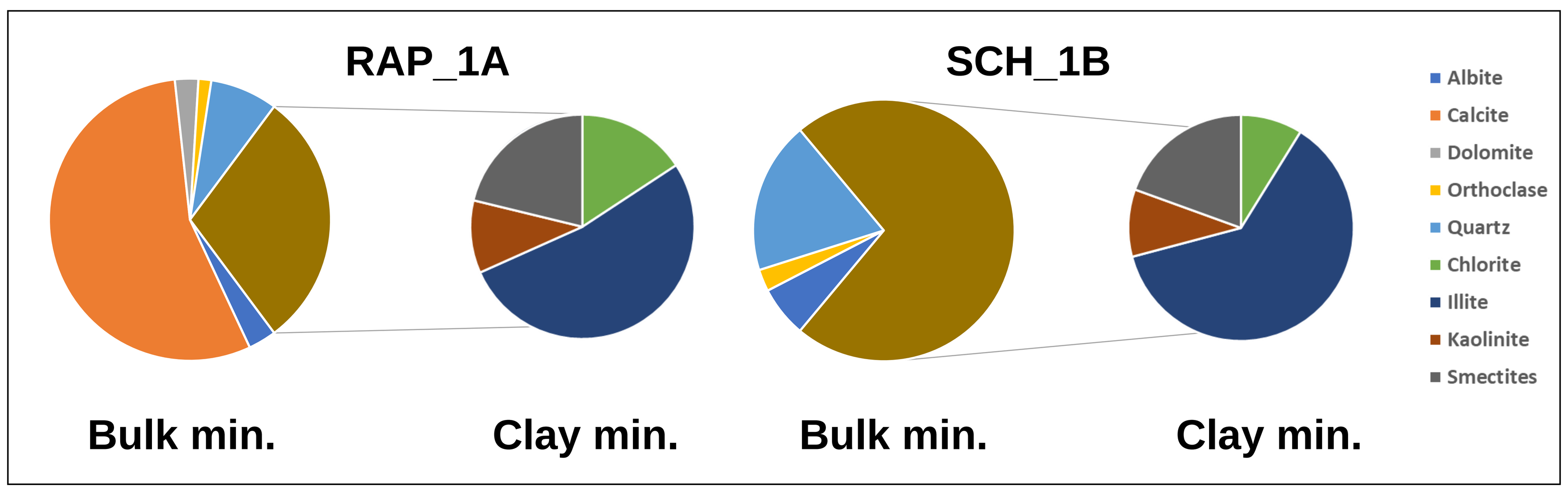


**Fig. 7**: Mineralogical makeup of two samples

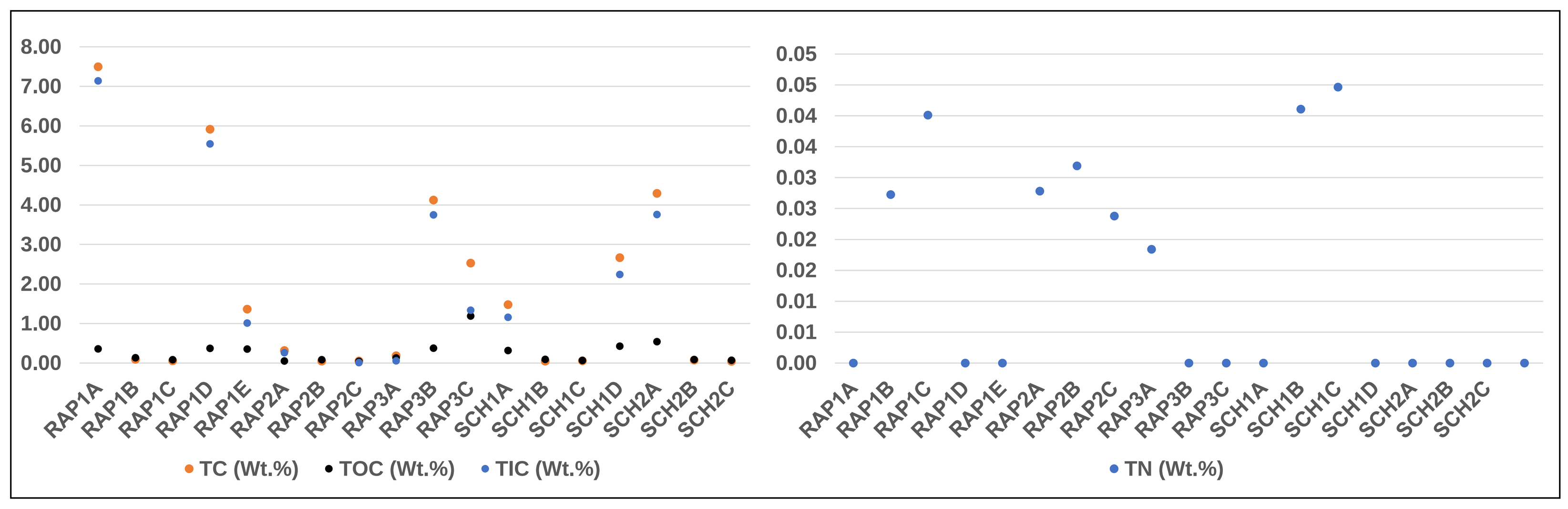


**Fig. 8**: Chemical makeup of all samples, TS(Wt.%) = 0 over all samples

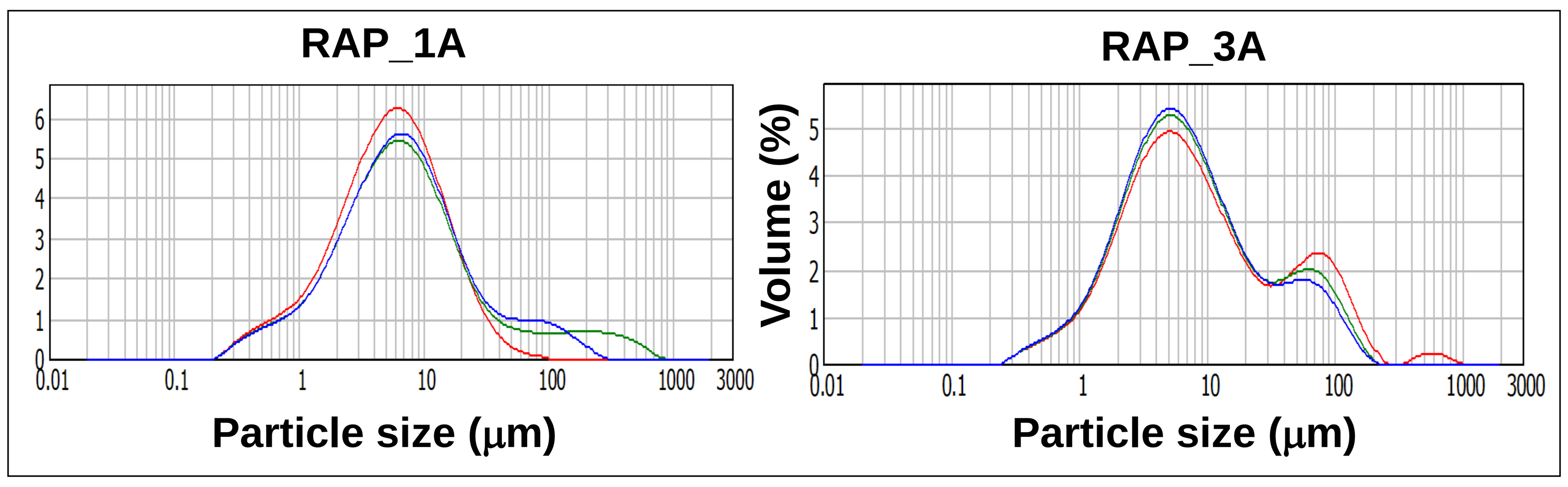


**Fig. 9**: Particle size distribution of two samples

**XRD**: Overall variability in mineralogy composition is low, but the variability in quantity of each mineral is strong. Clay mineralogy is stable over all samples.
**CNS**: No clear trends are visible.
**PSD**: Two types of distribution were curves identified: Monomodal and bimodal distributions.

## 6 Discussion

**Well logs** → Large sandstone bodies present in south of study site

**Drone photos** → Large sandstone bodies identified, spanning 10s of meters

**Palaeosols** → No clear trends in chemical composition
→ Steady clay mineralogy and particle size
→ Regional diagenetic signal

**Potentially good reservoirs, albeit with very low predictability from the surface**

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