

Figure 1: DT-1b borehole data: Caliper, Gamma ray (GR), wireline (MSUS) + core magnetic (MSUS_C) susceptibility, deep electrical resistivity (LLD) + mud resistivity (RMUD) + aperture of open fractures, sonic P-wave velocity (Vp), VSP P-wave velocity, fracture dip, core lithology, cluster analysis

Summary

The first borehole of the ICDP project Drilling the Ivrea-Verbano zone (DIVE), DT-1b, in Ornavasso, Val'd Ossola (Italy), was completed in December 2022 to a depth of 578.5 m. Geophysical borehole experiments comprising a suite of downhole logging and vertical seismic profiling (VSP) measurements were conducted. The poster shows an overview (Fig. 1) and the preliminary analysis of the data collected.

Borehole geophysics

Magnetic susceptibility: Amphibolites and some metapelites exhibit locally high values of magnetic susceptibility (MSUS) in the order of $10 \cdot 10^{-4}$ SI, which are confirmed by measurements performed on drilled cores on-site with a self-built manual core scanner.

P-wave velocities: Sonic P-wave velocities and preliminary P-wave velocity estimates of the VSP data are generally consistent. The average P-wave velocity estimate from the VSP is 5.4 km/s which is slightly lower than the average estimate of 5.5 km/s obtained from the sonic logs.

Fractures and breakouts: Several fractures are encountered within the drilled rock mass, exhibiting a NNW-SSE orientation and a variation of dip angles as identified by acoustic televiewer (ATV) data (Fig. 2b). Open fractures are clearly visible on image data (Fig. 2a) and correlate with low resistivity anomalies. Several breakouts with a NW-SE direction (Fig. 2c) are also visible on the ATV data between 450m and 550m.

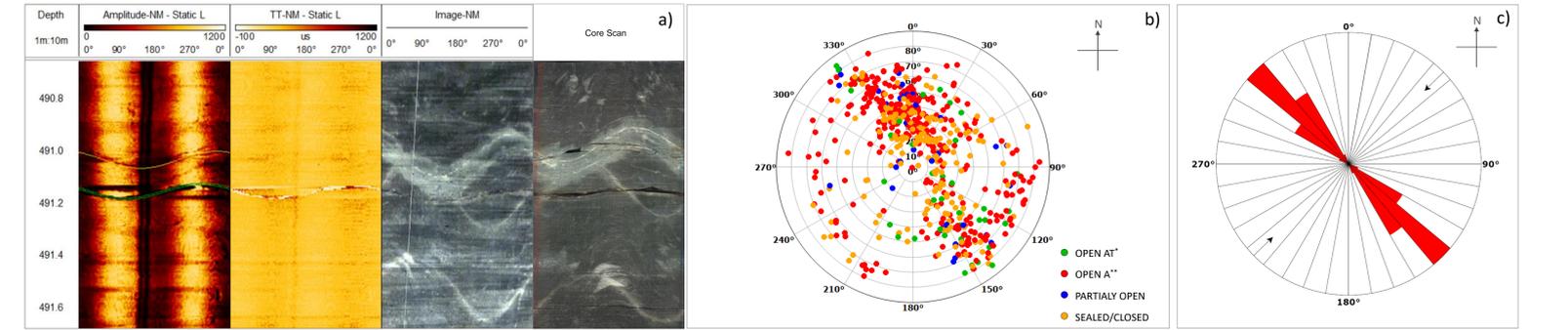


Figure 2: a) Fractures shown on the image data (ATV Amplitude image, ATV Travel-time image, OTV image, Core scan); b) Stereonet plot (polar-line) of fractures and c) Rose diagram of breakouts obtained from ATV data. *AT: fractures visible on amplitude and travel-time image and **A: visible on amplitude image

Rock mass classification

The wireline logs broadly correlate with the core lithology. To further investigate this, we apply to the logs an unsupervised classification workflow (Fig. 3). After a correlation analysis, the natural gamma and magnetic susceptibility (Fig. 4a) data are chosen for the cluster analysis. A comparison of the cluster analysis (Fig. 4b) with the core lithology (Fig. 1) shows that the amphibolites are mostly represented by cluster 1, while most metapelites fall into cluster 3, some into cluster 2 and a few into cluster 1.

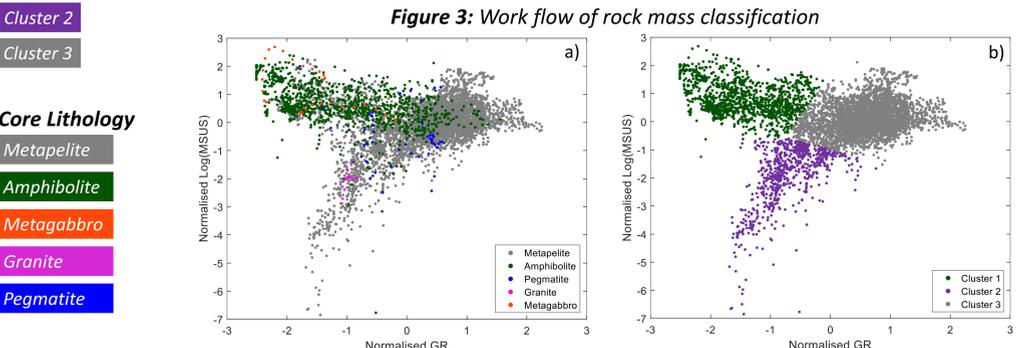


Figure 4: a) Normalised GR Versus Normalised MSUS cross plot; b) Classification results

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References: ¹Kitzig, M. C., 2018. <http://hdl.handle.net/20.500.11937/68385>

