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Types of heterogeneities and deformation mechanisms in blueschist rocks: an example from an exhumed subduction complex in Ishigaki Island, Ryukyu Arc

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The geological properties of the subduction interface, such as stable metamorphic assemblages and the rheology of shear zone rocks, change with depth. Studies based on seismic and geodetic observations suggest that these changes can be accompanied by differences in seismic styles. In this realm, slow slip events (SSEs) and related tremor signals, grouped as episodic tremor and slip (ETS) events, have been detected down-dip of the subduction megathrust seismogenic zone. A wide range of mechanisms, some invoking rheological heterogeneity, has been proposed to explain ETS occurrence. Given that ETS events accommodate most of the plate interface displacement in a depth range below the seismogenic zone, it is of great interest to understand the rheology of the rock lithologies that are likely to host ETS along the deep subduction interface.

Here, we present data from an exhumed subduction complex in Ishigaki Island, Ryukyu Arc. In particular, we analyse the Triassic high pressure-low temperature Tomuru metamorphic rocks, which comprise blueschist and greenschist facies metabasites that underwent subduction-related deformation. These rocks offer an important natural laboratory in which to study the characteristics of blueschist deformation structures to infer rheology and, in particular, the role played by heterogeneities in an environment comparable to modern ETS down-dip of the seismogenic zone.

Through multiscale and multidisciplinary, field- and laboratory-based studies, including quantitative microstructural and image analyses, we focus on two main topics. Firstly, we aim to understand blueschist rheology, by documenting the deformation mechanisms active in blueschist rocks through electron backscatter diffraction (EBSD), in order to quantify intracrystalline deformation and lattice preferred orientation (LPO) development. Secondly, we study the effect of grain size on blueschist foliation development and, ultimately, on blueschist deformation. Through these analyses, we hope to constrain both subduction interface strength and dominant mineral- scale deformation mechanisms at blueschist conditions.