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Blueschists and Eclogites from the Malpica-Tui Unit (NW Iberian Massif)

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The Malpica-Tui Unit (MTU) recorded blueschist- to eclogite facies metamorphism during the onset of the Variscan collision. According to their metamorphism and tectonostratigraphy, this unit can be separated in two sheets: a Lower Sheet (LS) of continental affinity, where felsic orthogneisses and turbiditic metasediments predominate and an Upper Sheet (US) that represents a volcano-sedimentary sequence viewed as a more distal part of the same continental margin, extremely attenuated, and transitional to an oceanic domain. A several meters thick layer of mylonites and ultramylonites marks the contact between the Upper and the Lower Sheets.

The US of the MTU outcrop in a small synformal structure, and is formed by a basal layer of finely foliated amphibolites and greenschists with N-MORB chemistry, and an overlying sequence of pelitic schists with minor intercalations of bituminous schists, cherts and carbonates. The mafic rocks are strongly retrogressed blueschists that locally preserve lawsonite pseudomorphs, whereas the metasedimentary rocks are chloritoid-glaucophane bearing schists in the lower part and garnet-phengite micaschists and phyllites in the upper part.

Different types of eclogitic rocks are common in the LS of the MTU, appearing as meter-sized lenses included in other igneous and metasedimentary rocks, but also as larger and discontinuous massifs. Eclogites sensu stricto are commonly fine-grained and nematoblastic, with a peak mineral assemblage consisting on garnet, omphacite, rutile, zoisite, phengite and kyanite. The effects of a later retrogressive, amphibolite to greenschist facies metamorphic overprint are widespread. Intermediate metatonalitic rocks were transformed into eclogitic gneisses. These rocks show a gneissic texture formed by light layers of quartz and phengite alternating with dark layers rich in omphacite, garnet, rutile, zoisite, and kyanite.

Petrological analysis involving pseudosections calculated with THERMOCALC and PERPLE_X shows that Peak metamorphic conditions in the LS are in the intermediate temperature eclogite facies. The US can be considered as a highly condensed metamorphic sequence with a basal part in the blueschist facies and an upper part without high-pressure relicts. The significant subtractive metamorphic jump between both sheets suggests that the mylonites that mark the contact are related to an extensional deformation.

The use of P/T–X (H_2O; Fe_2O_3) pseudosections together with petrographic observations indicates that the prograde evolution in subduction zones, under certain circumstances, may occur in fluid undersaturated conditions. Our data also reveals that the proportion of bulk Fe_2O_3 has a critical influence on phase equilibria. Therefore, modeling based on whole rock chemical analyses should evaluate the oxidation state during the metamorphic evolution through T-X pseudosections, because FeO/Fe_2O_3 ratio is probably modified by superficial alteration even in apparently fresh samples. From the P–T modelling we can also infer that, although these units are separated and displaced by tectonic contacts, the succession of P-T conditions probably reflects the original thermal structure of the subduction zone in the northerm margin of Gondwana.