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Sedimentary signatures of subduction within the Variscan accretionary prism: Kaczawa Complex, SW Poland

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The Variscan accretionary prism of the Kaczawa Mountains in the Sudetes (SW Poland) includes mudrocks that, although tectonised and metamorphosed, nevertheless preserve relict evidence of deposition- and burial-related processes in an active oceanic trench. They comprise widespread sedimentary mélanges together with more coherent stratigraphic units (some of which represent large olistoliths). The coherent units comprise mud-dominated turbidites that grade into likely hemipelagites, interbedded with coarse-grained volcaniclastic sandstones deposited as poorly organized high-density turbidites. There is an almost complete absence of body and trace fossils that likely reflects high rates of sedimentation and perhaps local anoxia; stratigraphical constraints are correspondingly poor. Previous interpretations have suggested a depositional age range of Ordovician to early Carboniferous; however, an observed continuum between depositional, diagenetic and tectonic characters suggests a narrower age range.

The mud-dominated deposits show evidence of pervasive early soft-state deformation linked to dewatering, consistent with sedimentation taking place during ongoing subduction. In particular, we identify a trend of progressive stratal disruption linked to variations in fluid throughput and sediment rheology. Thus: (1) The sedimentary lamination is essentially undisturbed, except where disruption has taken place by the clear effects of loading of sand layers into underlying mud more or less at the instant of deposition; (2) Diffuse streaks of mud more or less perpendicular to bedding are superimposed upon the primary stratification and locally grade into discrete veins that begin to cut across and disrupt bedding; (3) The mud veins become better defined, more closely spaced and pervasively cut across the bedding. Where there is a marked contrast in rheology (in sand-mud interlayering), the sand laminae become pervasively disrupted into a chequer-board style appearance.

The key factors here seem to be rapid rate of sedimentation overall to give rise to successions of water-saturated muddy sediment; the resultant compactional dewatering may have been enhanced by throughput of fluid expressed from actively deforming strata atop the descending plate. The mud veins in particular resemble similar phenomena that have been attributed to multiple fracture formation in soft sediment by the passage of earthquake waves.

Our analysis suggests that the deformation processes effectively began immediately upon sedimentation, was widespread in, and typical of, the depositional environment, and then persisted through burial before grading into shear-dominated tectonic deformation described by other authors.

We interpret this set of characters as being consistent with deposition in a submarine trench with active subduction, as previous regional geological studies and the tectonic fabric studies have indicated. We suggest, further, that the assemblage of characters that we have recognized, particularly in the mud-dominated strata, may prove useful elsewhere as a guide to accretionary prism environment.