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Structure of the Inner Bristol Channel and Severn Estuary borderlands, UK: regional mapping and seismic interpretation yield a refined model for mountain front deformation and inversion.

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Decades of work has been completed on Variscan geology of the inner Bristol Channel and Severn Estuary, yet there are few structural models that correctly portray their regional framework. Many published charts loosely depict the positions, strikes and nature of the Variscan deformation front and its geometry across SE Wales. Thus, we correlate seismic data with coastal outcrop at appropriate scales and detail, to present a refined model for the front.

Coastal outcrops, in conjunction with known crustal-scale seismic data: BIRPS, SWAT and LISPB, are combined with archives of intermediate scale: wide-angle reflection, seismic refraction and reflection records. They justify a reinterpretation of the front and may explain the geometry and kinematics of its foreland. Using these data, we draw new sections from north Devon to South Wales showing the position of structural units, both Palaeozoic and Mesozoic, affected either directly by thrusts, folds and disturbances or indirectly through structural inheritance during reactivation.

We correlate extracts from SWAT lines 2 and 3, a reinterpretation of LISPB data and the new fine-scale sections, S-N across the inner channel and W-E across the estuary. They enable the synopsis of crustal-scale data and regional maps. We find from measurement of several hundred lineaments and planes along the borderlands that the predominant orientation is ENE-WSW, unlike the central Bristol Channel which is WNW-ESE. All these, plus outcrop scale geometries and striation analyses, support the new tectonic partition of SE Wales and west of England.

Much information on the partition boundaries can be gathered from the marine geography of the estuary using Admiralty charts that yield accurate soundings. Seabed profiles across the estuary illustrate the positions of bedrock. Many align with onshore structure both locally and on the grander scale and through 3D reconstruction, we find that a crucial confluence of three discrete trends of lineament converge near Flat Holm and Steep Holm and may represent the pristine Variscan WNW, the Caledonoid NE and pervasive NNW trends. These islands in the estuary are sentinels at a boundary to the hybrid terrane that underlies SE Wales.

Mesozoic strata of marginal to distal facies, preserved close to negatively inverted faults with partial growth, mark the reactivated stems of Variscan ramps and NE disturbances with significant thrust displacements. We note two phases of negative inversion require restoration in order to reconstruct the orientations within the Variscan basement. In addition, close examination of late (Tertiary) fault history of the estuary is required to adjust basement trends and displacements to get a better sense of rotation within the Palaeozoic foreland.

Through restoration the new hybrid sub terrane preserves characteristics of Variscan and Caledonoid trending faults and we deduce that a rotation in major thrust trajectory occurred contemporaneously with reactivation of deeper lineaments. This was followed by a structural decapitation as shallow-level thrusts encroached SE Wales, during late stages of the Variscan Orogeny. Finally, the detached stems were incorporated into an imbricate fan which was significantly affected by post-Carboniferous inversion.