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A demonstration of the tectonic evolution of the inner Bristol Channel UK: application of structural geological analogues to interpretation of legacy and new seismic data.

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Advances in seismic imaging technology can discourage the integration of outcrop data into modern interpretation workflows. Yet, instigation of hydrocarbon exploration still requires the use of legacy seismic data, especially within mature petroleum provinces. Typical exploration workflows include expensive pre-stack seismic reprocessing, to better resolve exploration targets. This is a resourceful but timely process that can be enhanced by using structural geological analogues. The inner Bristol Channel has extensive outcrop: to the east the Severn Estuary, to the north the South Wales Coalfield and Vale of Glamorgan and to the south along the Somerset, Devon and Cornish coastlines. These sources of prolific data, combined with legacy exploration refraction, reflection and earthquake seismology, make the inner Bristol Channel an ideal natural laboratory to integrate analogues with seismic information and to produce realistic interpretations and explanations of complex structural heterogeneities especially in places concealed by Mesozoic and Quaternary cover, marine waters and estuarine sediments typical of the inlet. Successful structural analysis is always reliant on well-processed pre-stack seismic data. It is demonstrated however that numerous known structural inversion events also necessitate the best choice of analogues to resolve the geometry and kinematics of any major faults offshore accurately enough to reach a reliable understanding of the petroleum system. Here, in response to the Department of Energy and Climate Change (DECC) 2016 data release and the 31st licensing round, we use case studies from the inner Bristol Channel to demonstrate the value of structural geological analogues by integrating them into 1985 2D legacy seismic data at an early stage in the seismic interpretation process. With suitably chosen analogues, structural dissection and reconstruction are carried out to generate geometric and kinematic models. The wider waters of the Bristol Channel are situated in quad 105; in which investigation was instigated in the 1970's by major exploration companies. Currently, an interest in reliable structural analogues is made more relevant by the fourteen exploration licenses held onshore in south west England and South Wales. Thence our study augments the extensive field work carried out over at least three decades of academic research by generations of scholars. The targeted investigations conducted along the southern coast of Wales and the north coast of Somerset, Devon and Cornwall lead to revised syntheses, to better

extrapolate, predict and model the structural architecture beneath the inner Bristol Channel. Exemplary Welsh field analogues are accounted in detail, measured, restored and integrated into an interpretation of the 2D 1985 Western-Geco dataset (WG85 2D 2001). The analogues include Trwyn-yr-Wrach, the Cold Knap, St Mary's Well and Sully Island, among many others. In conclusion, the practical methodology exemplifies the geometric WNW-ESE lateral changes in structure and the effects of numerous kinematic phases and recent seismicity upon the architecture of the inner Bristol Channel basin as well as its relic-fabric. This demonstration of analogues improves immensely the geological understanding of seismic reflection projects whether legacy data, reflection, refraction or seismology and should remain relevant for many more crucial and modern acquisitions.