HIGH VELOCITY LAYER BENEATH SEISMIC REFLECTOR 'X' IN THE BRISTOL CHANNEL MAY BE CARBONIFEROUS LIMESTONE: IMPLICATIONS FOR A POSSIBLE EXMOOR-CANNINGTON PARK THRUST: DISCUSSION TO SMITH *ET AL.* 1998

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We welcome the paper by Smith *et al*. (1998) as an important contribution to the debate regarding the geological significance of Reflector 'X' under the southern Bristol Channel. However, whilst acknowledging that the high velocity layer beneath the reflector might possibly be Carboniferous Limestone, we have major reservations about the validity and strength of the geophysical and geological arguments advanced to support this idea.

The paper resurrects an earlier hypothesis that a major thrust (referred to in the paper as the Exmoor-Cannington Park thrust, ECPT) crops out off the north Devon coast. Reflector 'X' is interpreted as the top of the Carboniferous Limestone in the footwall of the ECPT and the 6.2 km/s refractor under north Devon is interpreted as the ECPT itself where the footwall is composed of Carboniferous Limestone. The postulated thrust is situated too close to the coastline to be imaged on marine seismic reflection sections. Onshore, there are small scale thrusts in the vicinity of Foreland Point and these may point to the occurrence of a thrust of kilometre-scale displacement immediately offshore (Miliorizos, 1992). However, there is no direct evidence onshore for a nearby thrust structure with the very large displacement suggested by the authors.

Crucial to the new geological interpretation of the seismic data is the argument advanced by the authors to support a velocity of 6.2 km/s for the local Carboniferous Limestone. They present evidence from sonic logs derived from deep boreholes over a wide region to show that sonic log velocities of 6.0 km/s and above are encountered through Carboniferous Limestone sections. However, sonic log velocities are at best an unreliable guide to refractor velocities. This is perhaps unsurprising, given the difference in frequency at which the two velocity measures are obtained: tens of kilohertz in the case of sonic logs, sampling a vertical section of wall rock only a few tens of centimetres thick; 1 - 10 Hz in the case of deep refraction surveys, sampling horizontal travel paths up to several tens of kilometres in length. This enormous difference of scale is not a reason for rejecting the comparison the authors wish to make, but it argues for extreme caution in arriving at any firm geological conclusion.

The reinterpretation of a 5.77 km/s basal layer under seismic line 74/3 in the central Bristol Channel (Brooks and James, 1975) as Carboniferous Limestone appears reasonable. However, the attribution of velocity values of 5.95 km/s encountered along line 74/6, and 5.54 km/s along line 74/7, to Carboniferous Limestone is unsound since these are apparent rather than true velocity values; neither of the refraction lines was effectively reversed and, hence, true refractor velocities could not be derived. Only over very short sections of seismic lines B2 and C2 (Bayerly and Brooks, 1980; Mechie and Brooks, 1984), and at short recording ranges only (indicative of poor transmission characteristics and/or localised stratigraphic or structural complexity), are velocities close to 6.0 km/s encountered over Carboniferous Limestone in the Bristol Channel area.

The 6.2 km/s refractor velocity encountered under north Devon is, in fact, the highest value in the entire region, being somewhat higher than the basal refractor velocity of 6.0 km/s observed throughout South Wales and most of the Bristol Channel area. A value of 6.2 km/s is actually matched only along seismic refraction lines shot over the shallow Precambrian 'basement' rocks of Pembrokeshire (Mechie and Brooks, 1984).

In view of the above considerations, we regard it as an unreliable procedure to take sonic velocity data from boreholes over 100 km to the east of the study area and extrapolate the results into the north Devon area to explain a laterally very persistent refractor velocity of 6.2 km/s.

We have reservations too about the geological arguments advanced by the authors. In correlating the Cannington Park structure with a hypothetical thrust off the north Devon coast, they choose to ignore the uncertainties in along-strike structural correlations resulting from the existence of major NW-trending Variscan structures, such as the root structure to the Watchet-Cothelstone-Hatch fault (Miliorizos and Ruffell, 1998). In this connection, it is worth noting that Reflector 'X' has been observed only in the hanging wall of the Watchet fault and the WNW-ESE trending Gravel Margin Fault of Miliorizos (1992). In South Wales and the Bristol Channel, large differences in structural style characterise the individual fault blocks compartmentalised by the major NW-SE trending faults. Given this, Cannington Park can be used reliably as an analogue *only* for the structural style existing to the east of the Watchet fault, which Miliorizos (1992) suggested may be in the footwall of the Bristol Channel thrust of Brooks *et al.* (1988). These uncertainties are not a reason for rejecting the hypothesis advanced by the authors, but they highlight the abundant scope for proposing quite different overall structural models to the one they present.

In the area where Reflector 'X' is identified, there is no evidence to quantify Variscan displacements on the hypothetical ECPT and the Bristol Channel thrust, yet the former is considered by the authors to have a large displacement and the latter a minimal one. In other words, the structural importance of a known and well-imaged thrust structure is ignored in favour of a postulated large displacement along a hypothetical thrust placed in the narrow gap between the southern end of the marine reflection lines and the north Devon coast.

The paper infers a thickening of the Carboniferous Limestone southwards under the Bristol Channel. There is no evidence for such thickening in the south-dipping Carboniferous Limestone slab seen on reflection sections west of the Watchet fault. Moreover, BGS mapping in the Vale of Glamorgan (Waters and Lawrence, 1987, Wilson *et al.,* 1990) reveals significant local thickness variations and facies changes in the Carboniferous Limestone, so it is clearly simplistic to use regional thickness variations and facies distributions along the Variscan belt to predict Carboniferous Limestone lithologies in the Bristol Channel.

In view of the above arguments, we remain highly sceptical about the authors' suggestion that Reflector 'X' might be Carboniferous Limestone.

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