Forum

Fault dating in the Canadian Rocky Mountains: Evidence for late Cretaceous and early Eocene orogenic pulses: COMMENT

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The bold assertions by van der Pluijm et al. (2006) do not survive close scrutiny. The technologically advanced procedures employed involve great ingenuity, but the results of the fault dating are suspect because:

1) They all rest upon the unwarranted tacit assumption that formation of "authigenic" illite in fault gouge occurred during thrusting rather than subsequent to thrusting—an assertion that requires supporting evidence.

2) For two of the six sample localities (#9 and #13), the precise estimate of the age of the detrital illite component (107.2 Ma and 89.3 Ma, respectively) is substantially (>40 Ma) younger than the stratigraphic age of the host rock, which, at both localities, is Jurassic (>145 Ma). Hence, estimates of ages of authigenic illite components are also suspect.

3) Near the northern tip line of the Lewis thrust (locality #13), the estimated age of authigenic illite from the fault zone is 72.3 ± 2.3 Ma; but at Gould dome (locality #102), it is 51.5 ± 2.2 Ma. This discrepancy cannot be explained by out-of-sequence thrust displacement because, at Gould dome, the Lewis thrust and the Upper Cretaceous strata in its footwall are folded by the Allison Creek anticline and the Crowsnest Mountain syncline (Price et al., 1992), forced folds imposed on the Lewis thrust sheet by an anticlinal thrust duplex that formed in the hanging wall of the underlying Coleman thrust fault (Price, 1981). Final thrust displacement on the Lewis thrust at Gould dome must have occurred before displacement on the underlying thrust; it was in-sequence.

4) Variations in rates of subsidence and sediment accumulation in the foreland basin of the southern Canadian Rockies record flexure of the continental lithosphere that can be linked to the shifting tectonic loads imposed on it by the northeastward expanding thin-skinned thrust-and-fold belt (Price, 1973, 1994; Beaumont, 1981). Times of deep and rapid subsidence and sediment accumulation mark times of large and rapid thrusting. The stratigraphic section in the foreland basin of southern Alberta does not record a lull in thrusting between 72 Ma and 52 Ma; instead, the rate of subsidence was at a maximum over most of the interval from ca. 72 Ma until ca. 60 Ma, when the youngest preserved foreland basin strata were deposited (Price 1994).

5) Radiometric dating of igneous rocks that cut, and that are cut by, the Lewis thrust in northern Montana constrain the time interval of displacement on the Lewis thrust to >59 Ma and < 74 Ma (Sears, 2001). The initial displacement on the Lewis thrust and its southward continuations, the Eldorado and Hoadley faults, offset Cretaceous volcanogenic formations capped by 74 Ma ash beds that occur in both the hanging wall and footwall of the thrust. Final thrust displacement must have ended before the mid-Paleocene because undeformed 59 Ma dikes cut thrusts at the leading edge of the thrust sheet. The 59 Ma date is consistent with the 58 Ma U-Pb zircon date for the abrupt transition from contractional to extensional deformation in the hinterland of this part of the Cordilleran foreland thrust-and-fold belt (Carr, 1991).

6) The widespread regional crustal extension in the hinterland was linked kinematically to dextral displacements on intracontinental transform faults in northeastern and southwestern British Columbia. It began with an abrupt transition from Late Cretaceous–early Paleocene dextral transpression to late Paleocene–mid-Eocene dextral transtension (Price, 1994). Transtension culminated with early to mid-Eocene extensional exhumation of mid-crustal metamorphic core complexes, three of which expose the Late Cretaceous–early Paleocene regional basal detachment zone (BDZ) of the foreland thrust-and-fold belt. The upper part of the BDZ is exposed in the Valhalla complex of southern British Columbia (Carr and Simony, 2006). Both the BDZ and the underlying the Paleoproterozoic crystalline basement are exposed in the Monashee complex, which is north of the Valhalla complex (Brown et al., 1992). That part of the BDZ that is the hinterland equivalent of the Lewis thrust, together with underlying Archean crystalline basement, is exposed in the Priest River complex, which is south of the Valhalla complex in northern Idaho and Washington (Doughty and Price, 1999). Early to mid-Eocene (55–45 Ma) exhumation of BDZ from lower to mid-crustal depths is consistent with mid-Paleocene termination of thrusting in the southern Canadian Rockies.

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