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Tectonic Significance of Microstructures in Idaho-Wyoming Thrust Belt and Hinterland

Mechanics of foreland thrust belt development can be explained using paleostress orientations from dynamic analyses of microstructures in quartz, calcite, and dolomite. Deformation in the hinterland must also be considered since the two basic models—gravity spreading and lateral tectonic compression—predict substantially different stress fields in this region.

Petrofabric studies in the Meade plate show that compression was dominantly layer-parallel, trending approximately east-west. On overturned fold limbs, compression at 50-80° to bedding suggests a locking angle which agrees well with existing theoretical and experimental analyses of kink-folding. Observed kink-fold geometries may be a necessary result of ramp configurations in the decollement thrust surface. These data are in accord with either of the two principal models.

Dynamic analyses at scattered localities in the southern Idaho hinterland show primarily layer parallel or subparallel, east-west compressson in all demonstrably allochthonous rocks at all structural levels. Fold vergence and local overturning indicate eastward translation along the undated, but probably Mesozoic, younger-over-older thrusts characteristic of this region. Near metamorphic core complexes, Tertiary thermal events may have affected preservation of older microstructures. Parautochthonous Precambrian metasediments between foreland and hinterland record compression at high angles to bedding. The age and origin of these microstructures are unknown at present.

These studies indicate that maximum compression was nearly horizontal and oriented approximately east-west throughout southeastern Idaho during thrust belt activity. Therefore, the lateral tectonic compression model is favored.

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Coarsening-Upward Shelf Sequences in Aphebian Wishart Quartzite, Knob Lake Area, Quebec and Newfoundland

The Wishart Quartzite of the Aphebian Labrador Trough contains coarsening-upward sequences about 10 to 20 m thick consisting of three successive subfacies: (A) basal centimeter-scale beds of ripple cross-laminated, very fine to fine sandstone separated by shaly partings, (B) decimeter-scale beds of fine to medium sandstone with thin lamination and hummocky cross-bedding, and (C) medium to coarse sandstone with herringbone trough cross-bedding. The top and bottom contacts of the sequences are sharp, the transition from A to B is completely gradational, and the transition from B to C is abrupt but still gradational. Scattered slabs of syndepositionally cemented sandstone cap most of the sequences. The upsection changes in primary sedimentary structures and mean grain size both indicate a temporal progression from distal, low-energy to proximal, high-energy shelf deposition. The sandstone slabs are interpreted as lag gravels deposited during erosional hiatuses. Individual coarsening-upward sequences could have formed either by coastal progradation coupled with erosional truncation of the tops of the sequences (e.g., ravinement) or by aggradation on the offshore shelf. An offshore shelf origin is preferred for three reasons: (1) no sedimentary structures requiring subaerial exposure are recognized in any of the sequences, (2) very similar coarsening-upward sequences in Cretaceous strata of the western United States have been interpreted as offshore shelf deposits on firm stratigraphic grounds, and (3) although no known Holocene offshore shelf deposit is entirely analogous, all of the sedimentary structures in the Wishart sequences have been observed in cores from one or more Holocene shelf environments.

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Drill as Tool for Studying Mineral Deposits and Hydrothermal Systems

During 6,000 years of mining, many different kinds of mineral deposits have been found and much has been learned about their formative processes. In no example can we explain completely why a deposit formed where and when it did. Mining focuses on the deposit itself and leaves untested the much larger volumes of rock that were also involved in the formative processes. One major objective of a continental scientific drilling program will be to fill that gap.

The program will select several areas where extensively studied mineral deposits are known to be the result of old hydrothermal convection systems. Drilling will explore regions far below and beyond the known limits of mineralization to determine the extent and chemistry of the old system. Proposed sites are: Tonopah, Nevada; Tintic, Utah; Butte, Montana; and Santa Rita, New Mexico. Modern hydrothermal systems would also be drilled to study the hydrology and chemistry of present-day equivalents of the fossil ore-forming systems. Examples are the geothermal systems at the Geysers and the Salton Sea, California, and Yellowstone National Park, Montana. The metal-rich formation waters discovered in the Mississippi embayment and believed to be precursors of Mississippi Valley-type deposits would also be studied in situ.

Finally, it is proposed that a deep-drilling program be used to fill in gaps in our knowledge regarding the chemical heterogeneity of the crust. We must determine whether the heterogeneities control the observed distribution of mineral deposits or whether the chemistry and the deposits are both manifestations of larger scale processes.

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Upper Paleozoic Paleogeography of Idaho

In south-central Idaho, Mississippian rocks were deposited in flysch-trough and carbonate-bank environments. Lower Mississippian detritus shed from the Antler highland accumulated to a thickness of more than 3,000 m in an adjacent elongate flysch-trough and