further comparison of modern and ancient deposits improves our means of mining and utilizing coal.

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Wrench Fault Tectonics

Relations among basin formation, sedimentation, and uplift in response to wrench faulting are well documented, especially in California, and together with rock and clay model laboratory studies, the California examples provide considerable insight to the mechanics of wrench fault tectonics in both space and time.

Wrench faults are produced in both pure and simple shear deformation, but it is the unique nature of strain in simple shear which leads to the characteristic en echelon arrangement of related folds and faults, structures which constitute the principal traps for hydrocarbons along wrench faults in many parts of the world.

Coalescing and rotated fractures combine within the length of the fault zone to form a braided arrangement of faults around lozenge-shaped, uplifted, and downdropped blocks. Whether an uplift or basin develops depends on the bending geometry of the fault segments and the sense of slip across the wrench fault zone itself. Adjacent highlands along such tectonically active zones may shed great volumes of generally coarse sediment into these equally tectonically active basins, and such basins are typified by unusually thick sequences of coarse clastic sediments stacked in a shingled or Venetian-blind-like arrangement.

The structure along the edges of the uplifted blocks may be complicated in detail, involving the geometrical interplay of steeply and gently inclined strata together with variable components of dip and strike separation on faults of diverse attitudes. It is along these complicated fault block margins, however, where favorable traps for hydrocarbons can be anticipated and have yet to be explored in many areas.

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Prediction of California's Next Earthquake

A great earthquake, centered near Los Angeles or San Francisco, has the potential to be the greatest natural catastrophe ever to strike the United States in historic time. According to some estimates, as many as 10,000 people could be killed, 100,000 could be injured, and up to $40 billion damage could occur.

Against this threat, many state and federal agencies, universities, and private consultants are working overtime in California to fathom the riddle of how and why earthquakes occur, in the hope of gaining understanding of the earthquake process, and leading to timely predictions to reduce the loss of life and property.

Following examples which have been variously successful in the People's Republic of China, Japan, and the Soviet Union, American seismologists are designing, testing, and studying a wide variety of instruments and initiatives they hope will be successful in making predictions routine. Techniques and instruments range from traditional seismographs, tiltmeters, and creepmeters, to monitoring changes of gravity, magnetic field, and resistivity, to observing behavior of kangaroo rats, emission of radon gas, and measuring levels of water wells.

Results have been mixed. No one has issued a formal prediction, which demands that the time, place, magnitude, and estimated effects be specified, but several earthquake alerts have been given. To confound matters, however, earthquakes have happened in the center of heavily instrumented areas without a shred of precursory warning. One statistician has said that at the rate we are progressing, we shall not have another chance to predict a great earthquake in California for 100 years if we miss the next one, which some experts say will happen in the next decade.

This lecture gives an overview of the problems and techniques of predicting California's next earthquake, together with a discussion of the status quo which, at the time this abstract was written, included a possible volcanic eruption a few hours' drive from downtown Los Angeles.

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Abstracts of Papers

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Lithic Wackes of Early-Middle Eocene Lookingglass Formation, Southwest Oregon

The early to middle Eocene Lookingglass Formation is exposed over a wide area in southwestern Oregon. The formation contains a thick sequence of turbidite deposits consisting dominantly of very coarse to fine-grained lithic wackes, with minor amounts of pebbly sandstone, siltstone, mudstone, or shale. Sediments, mainly from the Klamath region on the south, and partly from a volcanic arc on the east, were deposited in a north-trending fore-arc basin approximately 125 by 155 mi (200 by 250 km) in size.

Within the lower part of the sequence, the lithic wackes are mainly thick-bedded, normally graded, pebbly sandstones and very coarse to coarse sandstones that contain a shallow-water marine fauna. Channel-fill conglomerate lenses occur within some of the thick beds of sandstone. This part of the sequence is interpreted as a proximal submarine-fan deposit. The lithic wackes of the upper part of the sequence, however, generally form sheets of thinner bedded, medium to fine-grained sandstone with more matrix. They contain deeper water marine fauna and are devoid of channel-fill conglomerate lenses. This part of the sequence is interpreted as a distal submarine-fan deposit. Sedimentation took place at a high rate and was accompanied by rapid subsidence of the basin.

The lithic wackes have undergone fairly intense diagenetic alteration, which includes cementation by calcite, silica, chlorite, and clay minerals; the replacement of feldspar grains, lithic fragments, and matrix materials by calcite and chert; and the recrystallization of chlorite. Cementation and compaction have considerably reduced the porosity of these sandstones.

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Application of Nonlinear Constraints to Processing of Seismic Data