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How to Correct Seismic Data to Improve Seismic Impedance Logs

Besides geometrical and velocity effects, two global parameters may disturb the comparison between acoustic logs recorded in a borehole and those derived from seismic data: (a) the amplitude spectrum of the basic seismic wavelet, which controls the power of resolution; and (b) its phase characteristics that monitor the resemblance. The latter is of major importance in stratigraphic interpretation of seismic impedance logs (recognition of geologic transitions). The most important causes of distortions can sometimes be determined and compensated. The seismic source signature needs to be recorded, analyzed, and processed to determine the seismic wavelet. Phase distortions due to recording equipment (geophones and laboratory) are very important, and need to be corrected. Travel into the earth introduces multiples and absorption. Multiples can be dealt with in the classic way with a few precautions. Then an estimation of the amplitude spectrum of signal and noise at a given time-depth provides one with a quantitative estimate of the best achievable resolution of the actual data, and the absorption curve in amplitude spectrum using the recorded source spectrum. A good match between experiments and theory leads to the estimated impulse response of absorption at a given time, and reversely, to an optimized (eventually time-varying) correction operator.

Further conventional deconvolution processes should not be used. Nevertheless, when distortions cannot be corrected, and if well data are available, a deconvolution program controlling both amplitude and phase can be used interactively to achieve an equivalent result.

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Paleobotany, Paleoenvironments, and Stratigraphy of Lower Kirtland Leaf Locality near Bisti, San Juan Basin, New Mexico

A new leaf locality has been discovered in Hunter Wash, near Bisti, in a sequence of mudstones, carbonaceous shales, siltstones, sandstones, and coal. The boundary between the Fruitland and Kirtland Formations is taken at the top of the highest carbonaceous shale above the highest Fruitland coal and below a prominent brown sandstone. The leaf locality lies within a 19-m measured section, about 4.3 m above the highest carbonaceous shale, within a gray-green shaly siltstone overlain by a sideritic concretionary lens. Poorly preserved bivalves and gastropods occur in the deposit, but leaves predominate.

Leaf collections contain the remains of ferns, conifers, and angiosperms; angiosperms dominate the assemblage. The most commonly found angiosperm genera found include *Cercidiphyllum, Cissus, Ficus, Laurophyllum, Myrtophyllum, Lantanus, Salix,* and *Rhamnus.* Study of the collection to date shows that most of the angiosperous leaves are of medium size with entire, or nearly entire margins and drip points. These features indicate a warm temperature to subtropical climate in the region during early Kirtland time.

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Seismic Amplitude Variations and Detection of Sand Bodies

An area offshore Louisiana with an abundance of well control and seismic data provides an opportunity to verify the presence of interpreted sand bodies. In gross aspect the seismic sections show two major zones: one with highly discontinuous reflections of modest amplitude and a deeper zone with continuous parallel reflectors of low amplitude. The latter is due to an overpressured shale section interrupted by poorly developed sands and hard streaks, while the former is dominated by laterally discontinuous blocky sands which can be readily mapped from seismic events. Looking at the sands in more detail, the reflectors are actually continuous, following time-lines, but the amplitudes diminish where the sands terminate. Thus, reflector amplitudes can be used to determine the distribution of sand bodies of the order of 70 to 100 ft thick. In one area a sand body can be mapped across a structural nose, delineating a structural/stratigraphic trap, and elsewhere the presence of gas is distinguishable from lithologic changes by the intensity and character of the associated seismic signature.

One-dimensional modeling indicates that seismic response to the sand depends principally on density contrast with the shales. Two-dimensional modeling based on well log parameters and seismically derived geometries suggests that the sand bodies may be due to localized deposition and have been enhanced by differential compaction.

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Dilation Brecciation—Proposed Mechanism of Fracturing, Petroleum Expulsion, and Dolomitization in Monterey Formation, California

The Monterey Formation has been selectively replaced by dolomite and subsequently fractured, brecciated, and relithified with several generations of dolomite cement. The two dolomite types are distinctive in morphology, color, stoichiometry, δC^{13}, δO^{18}, as well as insoluble and trace element content.

Dilation breccias evidently originate in embrittled rocks through a distinctive sequence of steps induced by tectonism: dilatancy, fluid expulsion, natural hydraulic fracturing, brecciation, hydroplastic flow, injection, and dolomite precipitation. Development is most abundant in, but not restricted to, areas of strike-slip faulting.

Initially, breccia clasts are angular, large, and closely fitted. In advanced development, smaller clasts appear unsupported and volumetrically subordinate to fracture-filling dolomites. Complex examples contain a very wide range of unsorted clasts and cement, similar to a slurry. They appear to be injected under pressure into swollen bedding planes and terminal fractures.

Tectonic stresses cause an initial compression and subsequent dilation (elastic) of rock microcracks and imperfections. With continued stress, the cracks are propagated inelastically and develop into major fracture networks. Fracturing associated with excess pore fluid pressures triggers an instantaneous flow of connate fluids across several hundred feet of newly fractured strata. The resulting sharp drop in fluid pressure and temperature causes rapid precipitation of fracture-healing dolomite. The relithified rock is then subject to renewed dilatancy and rupture.

The dilatancy is pervasive and sufficient in magnitude to cause the expulsion of indigenous petroleum held initially in the organic matrices of the relatively impervious Monterey Formation. Several periods of petroleum migration are recorded in breccia paragenesis.