Attributes of Zoeppritz Elastic Impedance

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Abstract

Zoeppritz Elastic Impedance (ZEI) (Ma and Igor, 2005) is derived by extending the concept of Elastic Impedance (Connolly, 1999) and ray-path elastic impedance (Ma and Igor, 2004; Santos and Tygel,2004). Unlike the existing acoustic impedance (AI), elastic impedance (EI), and ray-path impedance (RI), ZEI gives an exact representation of the *P*-wave reflectivity at all angles and velocity/density contrasts and without any assumptions about the velocity/density structure. In several end-member cases, ZEI reduces to AI, EI, RI, and other approximate elastic impedance definitions. Using ZEI concept, not only the nonzero-offset seismic trace inversion problems and the non-uniqueness of the traditional AI and EI inversion can be explained well, but also ZEI reflects the accurate attributes of reservoir comparing with EI and RI. In this paper, we demonstrate some attributes of ZEI based on fluid substitution model. As the AI and EI, which have been successfully practised in hydrocarbon detection, reflect the near offset attributes of reservoir, ZEI reflects the exact attributes of reservoir both in near and large offsets. Our study shows that ZEI in large offset is sensitive to porosity and oil saturation, which might might be useful in the prediction of the fluid state of reservoirs and in time-lapse seismic observations. Especially, ZEI displays Class 2 AVO anomalies larger than EI. Brine-saturated and gas-saturated can be discriminated in nature logarithm ZEI and AI crossplots in Class 2 cases. This indicates that ZEI can be used as a good fluid-factor.