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Practical approach to estimate dynamic Young's modulus and Poisson's ratio using Passey's algorithm without sonic log in horizontal well

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Shale gas evaluation process can be summarized as the selection of sweep spot intervals in the vertical borehole and determination of hydraulic fracturing zones in horizontal borehole. Brittleness index used in the selection of hydraulic fracturing interval is calculated from dynamic Young's modulus and Poisson's ratio of wireline logging and MWD/LWD data. Young's modulus and Poisson's ratio are calculated from the sonic and density log data, and therefore the MWD/LWD in the horizontal borehole should be included sonic log to estimate the dynamic elastic constants. This paper proposes a practical method to estimate the elastic moduli based on Passey's algorithm if we can't use the LWD sonic log in the horizontal borehole. To estimate the TOC (Total Organic Content) using the sonic-resistivity log, density-resistivity log, and neutron-resistivity log using Passey's algorithm we use the relationship between Delta log R values and core derived-LOM (Level of Maturity) data. Dynamic elastic constants in the horizontal well, i.e. in case of sweet spot zones, can be estimated using the relationships between P-wave velocity and elastic constants in the vertical well, and similarity between the calculated Delta log R values from sonic-resistivity log, density-resistivity log, and neutron-resistivity log, respectively. From two Passey's algorithms such as sonic-resistivity log, density-resistivity log relationships in the vertical well, we can derive the P-wave velocity equating the two Passey's algorithms based on the similarity. Then we can derive the dynamic elastic constants using the relationships between P-wave velocity and dynamic elastic constants. Finally we can estimate the brittleness index from the Young's modulus and Poisson's ratio. We expect that this practical method can be effectively applied if we can't use the LWD sonic logging data of the horizontal borehole.