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Experimental evidences of slow P waves mode conversion on regular seismic data

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Introduction

Many authors have investigated low frequency anomalies that in principle are associated with hydrocarbon stored in sediments. Supported by different theories and differing by implementation and interpretation, papers on this line of research share the expectation that visco and/or poroelastic phenomena may be on the root of the anomalies that are ultimately direct hydrocarbon indicators. However, the very existence and/or measurement feasibility of the signal related to poroelastic phenomena in current seismic data are still a source of debate. This work brings a report of remarkable evidences that not only supports but also may motivate efforts to develop a processing flow tailored to highlight searched non-elastic related features possibly present in seismic data. Proper seismic data and processing flow are required and commented here on some mathematical and physical bases.

Evidences and interpretation

A series of papers by Genady Goloshubin et al. on how a mode conversion from P-waves to slow P diffusive propagation, that are expected to occur on the interface between pure elastic and poroelastic media, even at very low frequencies, are on the basis of two distinct attribute seismic volumes that, under ideal conditions, represent the so-called mobility factor, the product of the fluid mobility and the fluid density. These attributes were derived considering basically complementary physical phenomena: reflection and transmission at an interface. A careful local analysis of these attributes, reveals that energy conservation may be observed at some regions allowing for increasing confidence on its poroelastic origin. A local-synchrosqueezed time-frequency transform is shown to have the ability to provide the spectral analysis required to this work. Different acquisition and processing flows are also shown to impact decisively the analysis as expected.

Conclusion and Comments

A set of evidences of physical partition of energy on reflected and transmitted based attributes as well as an appraisal of the seismic data properties on which an analysis of the attributes was carried out allows for increasing optimism to search for poroelastic related phenomena in current seismic data.