Subject offered for a contract starting October 2019

SUBJECT TITTLE: ***Anisotropy from full waveform inversion of wide-angle data***

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Second Advisor/ Supervisor: James Ricketts (Dr), Schlumberger Cambridge Research

Host lab/ Team : *please fill in and leave out meaningless information*

IPGP- Team Marine Geoscience – UMR7154

Financing: IPGP/Schlumberger

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Seismic full waveform inversion has shown to be effective in estimating the medium and short wavelengths of elastic parameters, such as P and S-wave velocities. It is based on the true modelling of the seismic wave propagation in the earth and minimising the difference between observed data and synthetically simulated data. Until now, it has been used to estimate P and S-wave velocity models of the subsurface in 2D (Sears et al., 2010), 3D (Borisov and Singh, 2014) and for 2D time-lapse seismic (Queisser and Singh, 2012). For the waveform inversion to be successful, a combination of refraction, wide-angle reflection and near offset reflection data is acquired. However, in the presence of anisotropy, which is very common in sedimentary environment, the existing waveform inversion techniques would lead to a large misfit between data and synthetic and leading to erroneous results. Therefore, anisotropy (He et al., 2018) should be taken into account while inverting combined near and far offset data.

Since rays travel nearly horizontally for turning rays sensing mainly the horizontal component of velocity and nearly vertically for vertical reflection data that are influenced by vertical component of velocity. Therefore, if we invert the turning rays first providing horizontal component of velocity and then combined reflection and turning rays data using a constrained optimisation to obtain complete anisotropic parameters, which we propose to develop in this project. Initially, we shall carry out sensitive analysis, develop a prototype, test on synthetic examples and then apply to a real data set. We already have 12-15 km long offset data acquired by industry, and shall be testing this new algorithm to these data.

A student with strong background in physics, mathematics and interests in computing are encouraged to apply. The student will receive training in seismic modelling and inversion of seismic data and will work closely in collaboration with the colleagues at Schlumberger. They will integrate

in the dynamic Marine Geoscience group and will actively participate in broad range of research carried out at IPG Paris.

References:

Borisov, D. and Singh, S. C. (2015). Three-dimensional elastic full waveform in marine environment using multi-component ocean bottom cables, Geophys. J. Int. 201, DOI:10.1093/gji/ggv048.

He, W., Plessix, R., Singh, S.C. (2018). Parametrization study of the land multiparameter VTI elastic waveform inversion, Geophys. J. Int., 213, 1660-1672.

Queisser, M, and Singh, S.C. (2012). Full waveform inversion for time lapse quantitative monitoring of CO2 storage, Geophysical Prospecting, DOI: 10.1111/j.1365-2478.2012.01072.x

Sears, T., Barton, B.J., Singh, S.C. (2010). Elastic full waveform inversion of multi-component ocean bottom cable seismic data: Application to Alba Field, UK North Sea, Geophysics, 75, R109-R119.

Wang, H., Singh, S. C., Audebert, F., Calandra, H. (2015). Inversion of seismic refraction and reflection data for building long wavelength velocity models, Geophysics, 8-2, 1-14, doi:10.1190/GEO2014-0174.1