Title: Testing the relationships between structural growth rate and the morphology of submarine channels and reservoir facies.

Supervisors: Lidia Lonergan, Alex Whittaker and Mike Mayall, Imperial College London,

Summary: Results of work on the shallow subsurface of the deep-water Niger Delta fold and thrust belt have allowed us to quantify the rate at which the growth of structures with seabed expression can cause channels to divert and reroute their pathways. For example, channels that develop coevally with structural growth and that cross structures, do so in positions of recent strain minima and at very low interval strain (Jolly et al. 2016; 2017). By accurately measuring channel parameters such as downstream gradients, width and depth we have calculated the bed shear stresses and velocities down-system and how these change as channels interact with and incise across active structures (Jolly et al 2017; Mitchell et al submitted). Observations from buried slope channel complexes show that channels narrow as they cross structures, however the Pleistocene-modern seabed channels do not exhibit this width behavior. When we examine the larger cut-and fill channel complex beneath the most recent channels the parameters appear to more closely follow those for subsurface channels, so it appears to be a time-integrated response of turbidity flows interacting, and keeping pace with, growing structure. We can also demonstrate that active tectonics is an important control on whether slope channels are aggradational or erosional. Away from active structures a channel complex is dominantly aggradational, but once the channel system enters a zone with active structural growth the channel system becomes dominantly erosional. Our results have allowed us to refine our hypotheses of how, when and where channels are able to cut across growing structure, and our findings have important implications for predicting reservoir facies in the subsurface. These quantitative and observational results from the near surface give us greater confidence when interpreting deeper potential reservoir intervals in the subsurface and hence help reduce risk in prospect identification. We propose to test these results systematically in the Joint Development Zone of Nigeria & Sāo Tomé e Príncipe. This is an ideal area in which to do this. There are thrust structures active at the seabed, several seabed channel systems and importantly a stratigraphic framework from the well dataset. A 3d seismic volume and wells within the area are provided for the study by PGS.

Approach: The student will calculate structural growth rates for all faults in the area, and carefully study the response of the submarine channels systems in the JDZ to time-integrated structural growth. The student will test whether the outcomes and findings from the previous work can be applied widely to channels in the JDZ area and will develop a generalised model based on this.

Training: The student will join a strong research group in Imperial College with well-established strengths in structural analysis, 3D seismic interpretation, sedimentology and tectonic geomorphology. Training will be given in industry-standard computer software techniques for 3D seismic interpretation, and ARC-GIS. As part of the Graduate School of Engineering and Physical Sciences, the student will attend a series of transferable skills courses to equip her/him with research and communication skills.

To Apply: Please contact Lidia Lonergan (l.lonergan@imperial.ac.uk) or Alex Whittaker (a.whittaker@imperial.ac.uk) including a CV with your course grades with your email. The closing date for the Department of Earth Science and Engineering PhD studentships will likely be end January 2020; note that only UK residents are eligible for these awards. Overseas and EU students with alternative funding are also welcome to apply.

References