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Processing Challenges and Technologies of Ocean Bottom Node Survey

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ABSTRACT

Ocean bottom node acquisition (OBN) is one of the technologies used in the oil industry for deep marine exploration and development, but it has its advantages and limitations. This abstract addresses both aspects for an OBN survey acquired in complex bathymetry and subsurface geology. The water depth variations are abrupt and extreme ranging from 100m above sea surface (islands) to 1000m below sea surface. The survey was shot using three types of air-guns at different depths to accommodate shallow, medium and deep water. Receiver types used are OBN in marine side and land nodes on islands. The spatial sampling of receivers is sparse whereas the source sampling is much finer and distributed on a regular grid, which limits the seismic data processing flexibility to be primarily based on common receiver gather domain. Development of novel seismic data processing technologies is paramount in order to utilize the uniqueness of OBN acquisition and to address the processing challenges. Pre-conditioning of seismic data before summation is a necessary step for both hydrophone and geophone components to address Scholte and guided waves, high amplitude spikes, air-gun bubble and shear waves recorded in the geophone component. It provides a better and consistent calibration step prior to geophone-hydrophone summation. The summation process is a critical step to separate the down-going wavefield (i.e. receiver side multiples) from the up-going one. Due to deep water nodal acquisition, the data is naturally recorded with asymmetric ray paths given that the sources are just below sea surface and receivers are on seabed. After wavefield separation, the down-going dataset is binned to its common reflection point (CRP) and is redatumed to the mean sea level. Velocity analysis is then performed followed by a mirror imaging application to obtain a time migrated section. Alternatively, the up-going wavefield is redatumed to mean sea level using a ray-tracing based methodology for upward receiver continuation. Conventional processing and time imaging is applied to the upward continued up-going wavefield. The development of seismic data processing technologies provides an uplift in imaging for both up-going and down-going (receiver ghost) wavefields. The mirror imaging of receiver side multiples depicts a better result than conventional imaging of the corresponding up-going wavefield because of its extended subsurface illumination especially for the shallow part of the section.