

Seismic Stratigraphic Analysis and Hydrocarbon Potential of the Late Miocene Submarine Canyons in the Southwestern Margin of the Ulleung Basin, East Sea

Moohee Kang¹, Minwoo Lee¹, and Myong-Ho Park²

¹Korea Institute of Geoscience and Mineral Resources, Daejeon, South Korea

²Korea National Oil Corporation, Anyang, South Korea

Abstract

Submarine canyons are considered as the primary conduits for the transfer of sediment by turbidity currents into the deep basin, and are economically important because they have become targets of hydrocarbon exploration. Previous studies reported that Late Miocene submarine canyons developed in the southwestern margin of the Ulleung Basin, East Sea (Offshore Korea) where a producing gas field, Donghae-1, is located and thus are closely related to hydrocarbon presence in the region. However, despite numerous seismic surveys and a number of exploration wells, these submarine canyons have not been well documented. In this study, we investigate the morphology and seismic stratigraphic features of Late Miocene submarine canyons developed on the southwestern shelf margin in the Ulleung Basin and delineate a possible hydrocarbon trap associated with these canyons using new closely spaced (250 m apart) multichannel seismic reflection and borehole data. Submarine canyons in the study area are generally oriented in northeast direction, which is consistent with the trend of the present day submarine canyons and approximately perpendicular to the slope of the basin. In southwest, they display (show) generally a 'U' shape (U-shape morphologies), the width of the canyons being 1.5~2 km, and their incision depth is ~200 ms TWTT (~200 m). To northeast, the width and depth of the incision become wider and greater, canyons are more than 4.5 km wide and incise up to 400 ms TWTT (>400 m) into the underlying Miocene coarse-sediment dominated shelf deposits. Seismic profiles of the canyon fills show a range of different seismic facies, from high amplitude reflectors to subcontinuous or progradational reflectors with low-transparent amplitude. From the well-seismic calibration and their seismic reflection features, the high amplitude seismic facies in the basal of submarine canyons represent sand-rich deposits by gravity flow during lowstands of sea level. On the other hand, subcontinuous or progradational seismic facies with low-transparent amplitude are interpreted as fine-sediment deposits of TST/HST, which are the main component of canyon fills. The succession of these shale-fill canyons incised into the underlying sand-rich shelf deposits forms a potential trap of hydrocarbon accumulation. Within the trap can be seen a flat spot reflector and negative amplitude reflectors having AVO (amplitude variation with offset) anomalies, which may indicate the presence of hydrocarbons.