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Study of seabed and subsurface channels using high resolution 2D seismic data, Indus fan, Pakistan

Abdul Rashid Pasha
National Centre of Excellence in Geology, University of Peshawar, Peshawar

The study is carried out on high resolution 2D seismic data from the offshore Indus Fan, Pakistan. The Indus fan is located off the passive continental margin of Pakistan-India and is bounded by the Chagos – Laccadive Ridge in the east, by the Owen–Murray Ridges in the west, and by the Carlsberg Ridge in the south. The area lies in one of the tectonically active regions of the world with Makran accretionary complex lying at the convergent margin between the Arabian and Eurasian plates.

As a result of the collision between Indian and Eurasia Plates, about fifty million years ago, the Himalaya and other mountain ranges have been formed by under-thrusting and uplift of Indian and Asian crust. This uplifting has derived a high flux of sediment load transported through Indus river system and subsequently dumped into the Indus fan. The analysis of 2D seismic data of Indus fan reveals extensive gravity flow depositional elements like turbidity-flow leveed channels, channel over-bank deposits and debris flow channels that can be identified on the basis of its unique seismic signature.

The seismic data obtained from the upper part of the Indus fan reveals Holocene channel system on the sea bed. These data are evaluated along with the GLORIA sidescan sonar data to identify the channel migration, channel avulsion patterns and to compare the positions of the channels. Six seabed channels of different length and width were identified on the seabed. The flow direction of the channels is from North to South-west. These channels were identified on the basis of their erosional down cutting of the previously deposited sediments and their meandering and straight plan form. Knickpoint (reaches of anomalously steep gradient) evaluation was carried out for all the channels observed on the sea bed to further evaluate any major changes that occurred during the Holocene times, hence providing important information about the prevailing channel environments in the region.

The mapping of the channels and levees at three different locations (moving SW from the present day Indus Canyon) revealed a marked decrease in the number of channels and levees. Possible influences on the number of channels are discussed.

Finally laterally migrating and aggrading channels (identified by their U-V shaped high amplitude reflection) were observed in some of the seismic lines. These aggrading channels show interesting stratigraphy apparently caused by four to five cycles of channel infilling and re-entrenchment. A simple kinematic reconstruction was carried out to discuss the probable cause of formation of these aggrading channels.