Response of alluvial rivers of western India to Holocene climatic change

Issues addressed:
Have the alluvial rivers of western India responded to Climatic Changes?
What are the records that showcase the changing hydrologic regime?
How well are they preserved and how old are they?

Where are the records available –
- The preservation of sediment deposits in alluvial river basins is rare as the system is dynamic.
- The alluvial river basins of western India have unique geomorphic set up with quasi stable boundary.
- The late Pleistocene sediments are exposed as 30-40m high cliffs on either banks of these rivers forming ravines (Chamyal et al, 2003). At meander bends the present day to historic point bars are exposed and out at against the mid-late Holocene terrace surfaces.

Landforms in the Mahi River basin
Plan view of geomorphic setting in the Mahi River basin
A section across the Mahi River

Mid to late Holocene Records

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What has been observed!!!
- Slack water deposits (SWD) accumulated in the ravines and dated to ~5 ka. These represent events of extra ordinary flood during mid-late Holocene. These comprise fine silts and clay intercalations and are characterised by a fine parallel laminations and a blocky character.
- Terrace sediments showing pointbar facies in the Mahi River basin. The terrace sediments have been dated to mid-late Holocene (Kusumgar et al, 1998).
- Change in the channel dimensions from mid Holocene to present in response to hydrologic variation (regime based estimations).
- Regime based paleodischarge estimations for Holocene, historic and present channels.

The sedimentation in these river basins throughout Holocene has occurred in various domains such as the channel accretion deposits, channel fills, floodplains and slackwater deposits. The lithofacies association suggests that the deposition of the terrace sediments occurred in an unstable monsoon regime between 6000-2000 yr BP. The cyclic facies associations of silt and clay suggest repeated high and low precipitation periods.

The fluvial estimations based on the palaeo channel dimensions suggest that the mid-late Holocene discharge was higher; channel was much wider and had higher competence.

The periods of high precipitation are represented by the slackwater deposits preserved in the ravines of river basins, ending with the highest flooding event dated by OSL at 1.7± 0.5 ka.

Fluvial aggradation occurred around 2 ka when the point bars exposed above present day high water line in the river basins were deposited and subsequently incised by the meandering channels when the monsoon oscillated around 1.5 ka.

The bar deposition was mainly controlled by downstream accretion and the sediments show high degree of lateral and vertical heterogeneity in terms of facies and are inferred to have resulted by high stage flood events during cyclonic storms and the gradual waning flows.

A high volume flood mechanism has occurred from the Late Pleistocene in the river valley on its transit to the sea. These sediments are being incised, reworked and deposited in different domains in the present day ameliorating south west monsoon.

Late Holocene to present day Records

Record of late Medieval high flood event. The flood deposits contain numerous potshards and bricks belonging to late Medieval time. The associated discharge is estimated at 7300 m³/s.

Older point bars occur ~5-7m above the present day point bars and exhibit varied lithofacies indicative of fluctuating hydrologic conditions in the recent past.

Highlights
- The alluvial river basins of western India have unique geomorphic set up with quasi stable boundary.
- The late Pleistocene sediments are exposed as 30-40m high cliffs on either banks of these rivers forming ravines (Chamyal et al, 2003). At meander bends the present day to historic point bars are exposed and out at against the mid-late Holocene terrace surfaces.
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