River response to Quaternary climatic fluctuations: evidence from the Son and Belan valleys, north-central India

M.A.J. Williams\textsuperscript{a,\,*}, J.N. Pal\textsuperscript{b}, M. Jaiswal\textsuperscript{c}, A.K. Singhvi\textsuperscript{c}

\textsuperscript{a}Geographical and Environmental Studies, University of Adelaide, Adelaide, SA 5005, Australia
\textsuperscript{b}Department of Ancient History, Culture and Archaeology, University of Allahabad, Allahabad 211002, India
\textsuperscript{c}Planetary and Geosciences Division, Physical Research Laboratory, Navrangpura, Ahmedabad 380009, India

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Abstract

The last glacial period was cold and dry in peninsular India. In north-central India, the interval from 39±9 to 16±3 ka was associated with widespread and prolonged aggradation in the Son and Belan valleys. The aggradation ended with sustained vertical incision after 16±3 ka and reflects a return to warmer, wetter conditions. In this region, it would appear that terminal Pleistocene to Holocene river incision was broadly synchronous with a strong summer monsoon regime and higher levels of river discharge and the preceding river aggradation with lower discharge and a weaker or more variable summer monsoon regime.

Two older phases of prolonged aggradation followed by vertical incision are evident in the Son and Belan valleys before 43 ka. One of these phases is centred towards 73±4 ka when ash from the Toba mega-eruption in Sumatra was deposited across peninsular India. The following phase of aggradation has yielded infrared stimulated luminescence ages of 58±6 and 45±12 ka. The youngest phase of aggradation began towards 5.5 ka and seems to mark a return to a weaker summer monsoon regime.

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1. Introduction

The alluvial sediments of the Ganga, Yamuna, Son and Belan valleys of north-central India (Figs. 1 and 2) have been the focus of archaeological investigations over the past three decades (Sharma, 1973; Sharma et al., 1980; Sharma and Clark, 1983; Misra and Pal, 2002). A near complete prehistoric cultural sequence ranging from early Acheulian through Middle and Upper Palaeolithic to Mesolithic and Neolithic has been identified for this region and stands as an important regional datum for Indian prehistoric archaeology. The chronology of the cultural sequence from the late Upper Palaeolithic onwards is based on a growing number of radiocarbon dates, summarised in a later section. In an attempt to extend the chronology further, we have begun a systematic program of infrared stimulated luminescence (IRSL) dating of the alluvial sediments associated with faunal and other prehistoric cultural remains.

The aim of this paper is to present a more detailed chronology for the alluvial deposits and prehistoric cultures of this region and to propose a working hypothesis to account for the repetitive pattern of fluvial aggradation and incision during the late Quaternary. Since the region is well upstream of any possible sea level influence, it is buffered from the impact of glacio-eustatic fluctuations in base level. The alignment of the Son valley is controlled by the Narmada-Son tectonic lineament that is still prone to seismic activity (Vita-Finzi, 2004). However, within the study area shown in Figs. 2a–d, the surfaces of successive late Quaternary alluvial terraces are broadly parallel over distances of several hundred kilometres, indicating that the terraces were formed during a prolonged interval of tectonic stability. Any changes in river sedimentation and incision must, therefore, reflect local changes in plant cover and in the load to discharge ratios that themselves reflect fluctuations in regional climate.

2. The Quaternary alluvial formations of the Son valley

Initial archaeological enquiry in the Son and Belan valleys may have unduly emphasised the association