Journal of Asian Earth Sciences 42 (2011) 1371–1380

Contents lists available at SciVerse ScienceDirect

Journal of Asian Earth Sciences

journal homepage: www.elsevier.com/locate/jseaes

A Paleoproterozoic paleosol horizon in the Lesser Himalaya and its regional implications

O.N. Bhargava [a], Gurmeet Kaur [b,*], M. Deb [c]

[a] 103, Sector7, Panchkula 134 109, India
[b] CAS in Geology, Panjab University, Chandigarh 160 014, India
[c] CAS in Geology, University of Delhi, Delhi 110 007, India

ARTICLE INFO

Article history:
Received 28 November 2009
Received in revised form 31 July 2011
Accepted 1 August 2011
Available online 24 August 2011

Keywords:
Paleosol
Paleoproterozoic
Lesser Himalaya
Geochemistry
Precambrian metamorphism

ABSTRACT

A Paleoproterozoic paleosol horizon in the Himachal Himalaya along a basement-cover contact is identified on the basis of an integrated field-petrographic-geochemical studies.

The paleosol horizon is exposed in a road section along the Sutlej River near Karcham. It is represented by a 2–5 m thick sericite schist unit along the contact of the 1866 ± 10 Ma Jeori–Wangtu–Bandal Gneissic Complex (JWBGC) and the overlying sericite quartzite of the Manikaran Formation (Rampur Group), which is interstratified with 1800 ± 13 Ma tholeiitic flows in its basal part. The geochemical studies reveal a sharp drop in the concentration of SiO_2, Fe_2O_3, MgO, CaO, Na_2O and a rise in concentration of Al_2O_3, TiO_2, K_2O and P_2O_5 at the contact of granite gneiss and sericite schist. REE plots of granite gneiss, sericite schist and quartzite samples of the Manikaran Formation display similarity of pattern, fractionation between the LREE and HREE and comparable negative Eu anomaly. The total REE of the sericite schist and sericitic quartzite is lower than those of the granite gneiss.

Based on these studies the sericite schist is inferred to be a metamorphosed alumina-rich soil, which appears to have formed in a warm and humid climate in a waterlogged terrain of gentle relief, and is post-1866 Ma and pre-1800 Ma in age.

Apparent gradation from the strongly deformed amphibolite facies JWBC to the sericite schist with diffused contact indicates that the JWBGC was already metamorphosed and deformed prior to the development of the paleosol; thereafter both together with the overlying Manikaran Formation were subjected to low-grade metamorphism during the Himalayan orogeny. The JWBC is involved in the crystalline thrust sheet and is present throughout the length of the Himalaya. Thus, it is inferred that the Paleoproterozoic metamorphism was a regional event in the Himalaya at a time when the Indian Plate was part of the Nuna Supercontinent.

1. Introduction

Precambrian paleosols have been discovered and documented in large numbers in recent years by various workers from different geological environments. The interest mainly emanates from the suggestion (e.g. Holland, 1984; Retallack et al., 1984) that paleosols may be used to determine the oxygen content of Precambrian atmosphere and thus provide valuable information on early atmospheric evolution, because they formed at the Earth's surface in direct contact with the atmosphere. Apart from establishing a hiatus in the stratigraphy, the identification of paleosols in the Precambrian sequences, as the present contribution shows, can also have regional significance in the geological history of an area.

Paleosols are distinct petrologic entities, often very alumina-rich (Reimer, 1986; Wright, 1986). Three classes of criteria have generally been used to recognize the paleosols: biological traces, soil horizons and soil structures (Retallack, 1992). However, in areas with strong deformation and metamorphism subsequent to the formation of the weathering profile, such as those found in many Precambrian terrains, these criteria are of limited use. In some instances, Precambrian paleosols are also known to have suffered hydrothermal alteration as well. In such cases, study of geologic setting combined with petrological and geochemical studies of the sequence along a profile appears to be the most meaningful exercise. Such an approach, for example, has been successfully applied to the Early Proterozoic Hokkalampi paleosol in north Karelia in eastern Finland, represented by quartz–sericite schist (Marmo, 1992). However, even in this line of study doubts do linger regarding the distinction between the geochemical variations due to subareal weathering and those produced by any post-burial

* Corresponding author.
E-mail address: gurmeet28374@yahoo.co.in (G. Kaur).

1367-9120/$ - see front matter © 2011 Elsevier Ltd. All rights reserved.
doi:10.1016/j.jseaes.2011.08.001

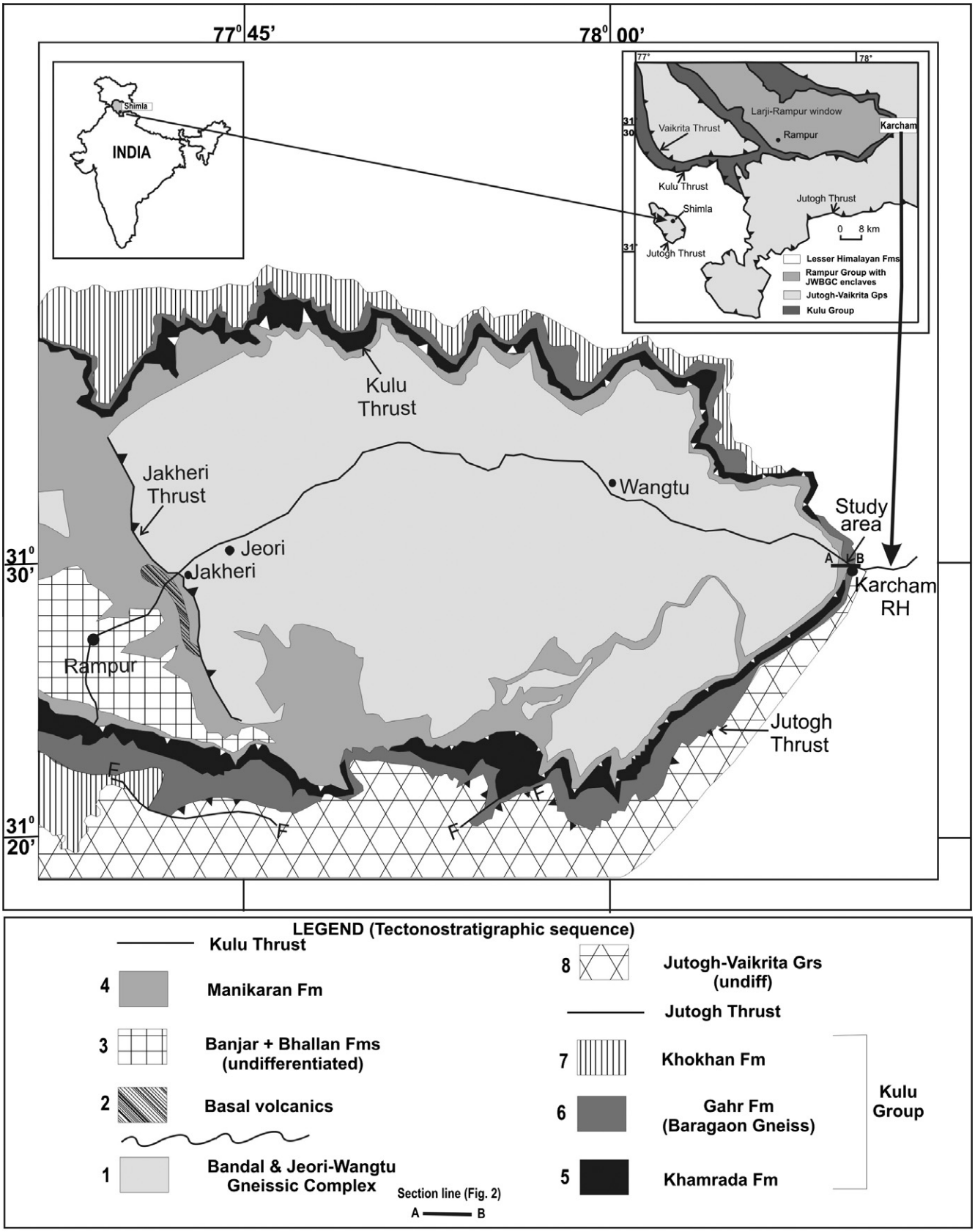

Fig. 1. Geological map of south-eastern closure of the Larji-Rampur Window; the key map shows regional geological setup of the window.

hydrothermal alteration along a litho-contact or a zone of shearing during metamorphism (cf. Palmer et al., 1989). Thus, probably the best results are obtained with an integrated approach using detailed field relationships, petrographic and geochemical signatures.