SHORTER COMMUNICATIONS

NAHANS—A PROBLEMATIC HORIZON OF NORTH-WESTERN HIMALAYAS

R. S. CHAUDHRI
Centre of Advanced Study in Geology, Panjab University. Chandigarh

Introduction: Lithostratigraphic position of the Nahans (Lower Siwaliks) in the Tertiaries of north-western Himalayas (Table I) has ever remained an enigma mainly because of their close apparent lithological resemblance with the underlying Dagshai/ Kasauli sequence. Though the Nahans of the Simla Hills have been studied in their various aspects by a number of workers including officers of the Oil & Natural Gas Commission and Geological Survey of India, yet no systematic attempt seems to have been made regarding the lithostratigraphic comparison of the Nahans with the underlying Lower Tertiaries which they resemble most. With a view to work out their exact stratigraphic position and relationship with the Lower Tertiaries in regard to provenance and environmental conditions, detailed comparative field and laboratory studies were carried out the results of which form the subject matter of this paper.

TABLE I

TERTIARY SUCCESSION IN NORTH-WESTERN HIMALAYAS

Upper Tertiaries (Modified after Pilgrim, 1913)	Upper Siwaliks (2000-2500 m)	Boulder Conglomerate Stage	Cromerian
		Pinjore Stage	Villafranchian
		Tatrot Stage	Astian
	Middle Siwaliks (2000 -2500 m)	Dhokpathan Stage	Pontian
		Nagri Stage	Sarmatian
	Lower Siwaliks (Nahans) (1500-2000 m)	Chinji Stage	Tortonian
		Kamlial Stage	Helvetian
Lower Tertiaries (Chaudhri, 1968b)	Kasauli Series (2000-2200 m)		U. Oligocene-L Miocene
	Dagshai Series (600-700 ni)		U Eocene-L Oligocene
	Subathu Series (1300- 1500 m)		U Palaeocene-U Eocene

Stratigraphical relationship of the Nahans with Older tertiaries: Medlicott (1864) placed Nahans (Nahun) in the middle division of his three fold classification and observed that hiatuses of significant importance separate the various units. Oldham (1893) advocated a perfectly gradational and conformable contact between the Kasaulis and the Nahans on the cart road to Simla. Sahni & Mathur (1964) also recorded a perfectly gradational and conformable junction between the Dharamsalas (Lower Tertiaries) and the Lower Siwaliks (Upper Tertiaries). This junction being not exposed on the surface was worked out by deep drilling in the Jwalamukhi region. On account of a close apparent resemblance, Pilgrim (1936) classified Nahans as Dagshais in the Kalka area and as Kasaulis in the Nalagarh region. This mistake,. however, was rectified by Heron (1936). Boileau (1954) was similarly confused in the Nalagarh area and the rocks classified by him as Lower Siwaliks were later found-belonging to Dharamsala (Dagshai-Kasauli) group (Sahni & Mathur, 1964).

The sedimentary junction of the Nahans with the underlying Kasaulis/Dharamsalas is rarely exposed. Wherever such a junction is traceable such as on the cart road to Simla (Oldham, 1893), it is invariably a conformable and gradational contact. In most of the exposed sections, however, the Nahans have a tectonic contact with the Lower Tertiaries. This junction is popularly referred to as ' Main boundary-fault '. Medlicott (1864), Middlemiss (1890), and Hayden (1933), however, considered this tectonic junction to be the original limit of deposition of the Siwaliks with the cliff faces of older Tertiaries. Heim and Gansser (1939) denoted this contact as a ' relief thrust'. Investigations by the author revealed beyond doubt that the junction between the Lower Siwaliks and the Lower Tertiaries is of a tectonic nature. Along this junction, large scale brecciation and mylonitization is observed. The contact is. marked by the presence of crushed carbonaceous matter which varies in thickness from 2 cm to 150 cm. Numerous water seepages and springs are noticed along this. junction. The throw is of a high magnitude, the south-western block representing the down throw side must have moved down at least 4,000 m resulting in the complete omission of the Lower Tertiaries. The fault plane dips in a north-easterly direction. The angle of inclination varies from 30° to 45°. In view of this the author proposes that the 'Main boundary fault' be better designated as 'Nahan thrust'. The age of the thrust is post-Miocene, perhaps, concurrent with the second major Himalayan upheaval.

Comparative petrological/sedimentological & heavy mineral studies: About seven hundred rock samples representing various lithologic units of the Subathus, the Dagshais, the Kasaulis and the Nahans were •subjected to detailed laboratory investigations, and only the salient points concerning the Nahans-Dagshais/Kasaulis relationship are recorded here.

Various lithologic units encountered in the Dagshai-Kasauli sequence include conglomerates (intraformational conglomerates/pseudoconglomerates), protoquartzites, lithic sandstones, calcareous sandstones, ferruginous sandstones and siltstones/ clays. In the Kasauli Series, due to slight impact of metamorphism, the matrix has turned into flaky minerals (Chaudhri, 1968, 1969c). Rock types met with in the Nahans are the same as observed in the Dagshai-Kasauli sequence. Moreover, there is a close similarity in the manner of superposition of various lithologic units of the Dagshai/Kasauli sequence and those of the Nahans. The pigmentation of the two formations also happens to be identical. There is not much difference in the degree of induration and cementation of the rocks of the Dagshai-Kasauli/Dharamsala sequence and those belonging to the Nahans. Very local variations, however, do exist as could be expected in such a thick (5,500 m) pile of sediments.

Most of the quartz of the arenaceous rocks of Lower Tertiaries show undulose extinction. This feature holds true for quartz of the Nahan Series also. Fragments of undecomposed parent rocks encountered in the Dagshai-Kasauli sequence include limestones, purple and grey shales, purple siltstones, purple and grey sandstones, quartzites, carbonaceous schists, chlorite schists and muscovite-biotite schists and gneisses. Exactly the same type of rock fragments are recorded in the Nahans during the detailed petrological studies of these rocks. Nature of chemical cement (carbonate, ferruginous) and mechanical matrix in the rocks of the corresponding types is also similar throughout the sequence.

Predominant size range of detritus of the Dagshai/Kasauli sequence falls in fine to very fine sand grade of Wentworth (1922). In the Nahans, however, the median values cross over to medium grade and more than 50% of the de'tritus constitute the medium to fine sand size range. A large proportion of sediments of the Dagshai/ Kasauli sequence fall in angular to subangular grades (Chaudhri, 1969b). This also holds true for the sedimentological parameters of the Nahans.

Heavy mineral studies reveal the presence of zircon, tourmaline, rutile, epidote, chlorite, biotite, anhydrite, garnet, pyrite, magnetite, hematite and ilmenite (anhydrite and pyrite restricted to Subathus only) in the Lower Tertiary sequence (Chaudhri, 1970). Detailed heavy mineral investigations of the Nahan Series reveal an identical suite of the heavies, viz., zircon, tourmaline, rutile, epidote, chlorite, biotite, garnet, magnetite, hematite and ilmenite. Staurolite reported by Raju & Dehadrai (1962) could not be traced in the present collection. Presence of this mineral was not traceable by Anand (1968) in the type area as well.

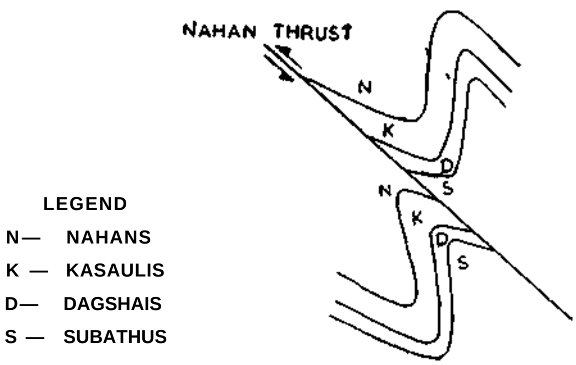

Figure 1. Diagrammatic section to explain the nature of Nahan—Subathu contact (not to scale)

Discussion and conclusions: A close similarity in the petrological, sedimentological and mineralogical nature of the Lower Tertiaries and that of the Nahans leaves no choice but to postulate a continuous sedimentation in the north-western Himalayas from Upper Palaeocene to the close of Miocene Epoch. Provenance for the Lower Tertiary sediments has been precisely worked out to be in the adjacent Himalayan region where acid plutonic rocks, low and medium grade metamorphics and sedimentary rocks were exposed to denudation (Chaudhri, 1966; 1969d). The present investigations reveal beyond doubt that the terrain which supplied detritus of the Lower Tertiary rocks was an active source of supply during the sedimentation of Nahans also. Plant fossils in the Nahans (Dayal & Chaudhri, 1967), general angularity of the detritus and high percentage of undecomposed rock fragments reinforce author's contention about transportation of the detritus over a comparatively short distance. The continuous stream of sediments was deposited in a shallow subsiding basin (Chaudhri, 1969a) as is evidenced by frequent occurrence of current bedding, ripple marks and pebbly beds in the rocks under discussion. The Nahans, thus, belong to the Dagshai-Kasauli sedimentation unit.

The orogenic movements at the close of Miocene epoch were mainly responsible for the upheaval and folding of the Nahans along with the underlying Older Tertiaries (Subathus, Dagshais and Kasaulis). A major fracture developed all along the NW Himalayan foot-hills (Fig. 1). The Nahans along with the underlying older sediments on the south-western side of this fracture must have sunk as their counterparts on the north-eastern side were rising. As a result of the differential movements, the Nahans acquired their present position. Due to difference in elevation, the Nahans covering the Kasaulis were eroded away at a much faster rate in the higher reaches. It is only in the relicts the gradational and conformable nature of the junction is observed, such as along the cart road to Simla. In the lower levels where the depositional contact of the Nahans with the older sediments is not exposed, deep drilling is the only confirmatory test. The finds of Oil & Natural Gas Commission in the Jwalamukhi region (Sahni & Mathur, 1964) stand testimony to the author's contention about the Nahan-Kasauli boundary.

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DETRITAL DOLOMITE'FROM UJHANI STRUCTURAL WELL NO. 1 GANGA VALLEY, INDIA

C. GUNDU RAO

Institute of Petroleum Exploration, Oil and Natural Gas Commission, Dehra Dun

Introduction: A detailed lithological analysis of the rocks of continuously cored interval 1099.03-1246.91 m in Ujhani st. well No. 1, Ganga Valley, revealed the existence of four lithological units viz. from the top (1) bluish gray dolomites, (2) dark green to dark brown shales, (3) red beds and (4) pale bluish gray to pinkish calcilutites. Some of the shales of unit 2, contain a fairly large proportion of minute, anhedral, subhedral to a few euhedral dolomite grains of 5 to 10 /j. size. These are considered to be detrital in origin. Further, an attempt is made to show that these are windblown (aeolian) in origin and the dolomite grains in rocks of unit 1, are nothing but diagenetically enlarged original wind blown dolomite nuclei.

Dolomite identification: Thin slabs of about the size 1" by 1|" were cut from the rocks of unit 1, and dolomite bearing shales of Unit *f)* 2, mounted on General Electric XRD-6 X-ray diffractometer with nickel filtered copper (Cu K a) radiation and scanned at the rate *of 2°* per minute over a range of 24° to 32.5° 2 *0* angle to identify prominent peaks of quartz, calcite and dolomite (Hughes, Bradley and Glass 1962). Figure 1, shows the diffractograms of a dolomite bearing shale *(a,* and a_s) and a dolomite rock of unit 1 (b). From these difractograms, in dolomite bearing shale, a prominent peak for quartz at 26.6° (d_o= 3.348 A) calcite at 29.4° (d = 3.03 A) and dolomite at about 30.6° to 30.9° (d = 2.9 A) 2 *d* angles my be observed. Of the two difractograms of dolomite bearing shale, a, shows a prominent peak for quartz, a minor peak for calcite and very subdued one for dolomite. Figure 1, a,, is a difractogram taken from a different part of the same slab. It shows a prominent peak for quartz and none for calcite and a minor one for dolomite. This would suggest that within the area of the slab, while quartz shows a uniform distribution, calcite and dolomite appear to be patchy in occurrence. The difractogram of the dolomite rock of unit 1, (Figure 1 b) shows a prominent peak for dolomite, a very subdued one for quartz and the calcite peak altogether eliminated. The quartz peak (d = 3.348 A) is slightly broad at the base. This suggests the occurrence of clay minerals (illite d = 3.335 A) along with quartz. Patterns taken from different parts of the same slab yield practically the same type of difractogram and therefore it may be presumed that the rock is a pure dolomite with minor quartz and clay minerals,