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Pseudo-amphibolites in the Southern Amphibolite Belt, Kohistan Arc, N. Pakistan.

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ABSTRACT: *More evidences strengthening the view of the existence of (a) pseudo-amphibolite forming as a result of reaction between pre-granitic hornblendite or amphibolite and the granitic magma and (b) of certain hornblendites forming as a result of reaction between pre-granitic amphibolite and the granitic magma, in the southern amphibolite belt of the Kohistan island arc, are presented in this paper.*

INTRODUCTION

The southern amphibolite belt of the Kohistan island arc, north Pakistan, is comprised of amphibolites as the dominant rocks in addition to dunites, peridotites, pyroxenites, hornblendites, metapillows, olivine gabbros, norites, diorites, tonalites, trondhjemites, granites, hornblende pegmatites, granitic pegmatites, applites and various types of veins (Jan, 1990). These rocks have been investigated at several locations by different workers who have put forward various theories regarding their origin (Jan, 1979; 1990; Jan & Howie, 1982; Khattak et al., 1985; Shah et al., 1991; Hussain, 1991). Ahmed (1978) suggested epidote amphibolite facies metamorphism having been dominantly operative in the evolution of rocks from the southern amphibolite belt of Taghma area in Swat (Fig.1). Khattak et al. (1985) regarded these amphibolites as meta-igneous and possibly plutonic while hornblendites and hornblende pegmatites as the products of metamorphism in the presence of a fluid phase during amphibolite facies conditions. In a recent study Hamidullah et al. (1990), working on the petrology of the Southern amphibolite belt rocks of Mahak (Fig.1), described their development from a basic tholeiitic magma, recrystallized under amphibolite/garnet amphibolite and epidote amphibolite facies conditions. These authors also described certain amphibolites which they called pseudo-amphibolites representing hybrids and having been formed due to reaction between pre-granitic hornblendites/amphibolites and the granitic magma. In addition, they described syn-granitic hornblendites formed as a result of interaction between amphibolites and the granitic magma. In this paper new field evidences are presented to strengthen the view of the granitic magma playing a major role in the formation of pseudo-amphibolites and syn-granitic hornblendites.

DATA

At the southern extremity of the Mahak hornblendite body, in a road cut (Fig.1, spot A) granitic veins are intruded and have gradually transformed hornblendite to an inhomogeneous hybird rock. This rock vary in colour from grayish-green and grayish white to a much lighter colour with a dioritic or granodioritic appearance. Relics of the original hornblendite are however, still retained in it (Fig. 2a, b). A few meters east of this outcrop a more or less similar phenomenon is noticed in amphibolites transformed to a lithology of lighter colour due to the interaction of the granitic magma.

On the other hand, along the eastern contact of the Shah Dheri granitic mass (Fig. 1, spot B), the fine grained banded amphibolite (metavolcanic?) intruded by granitic veins has developed hornblende crystals but has perfectly retained the former amphibolite in the background (Fig. 2c). This phenomenon has produced horblendite with >90% hornblende in banded amphi-

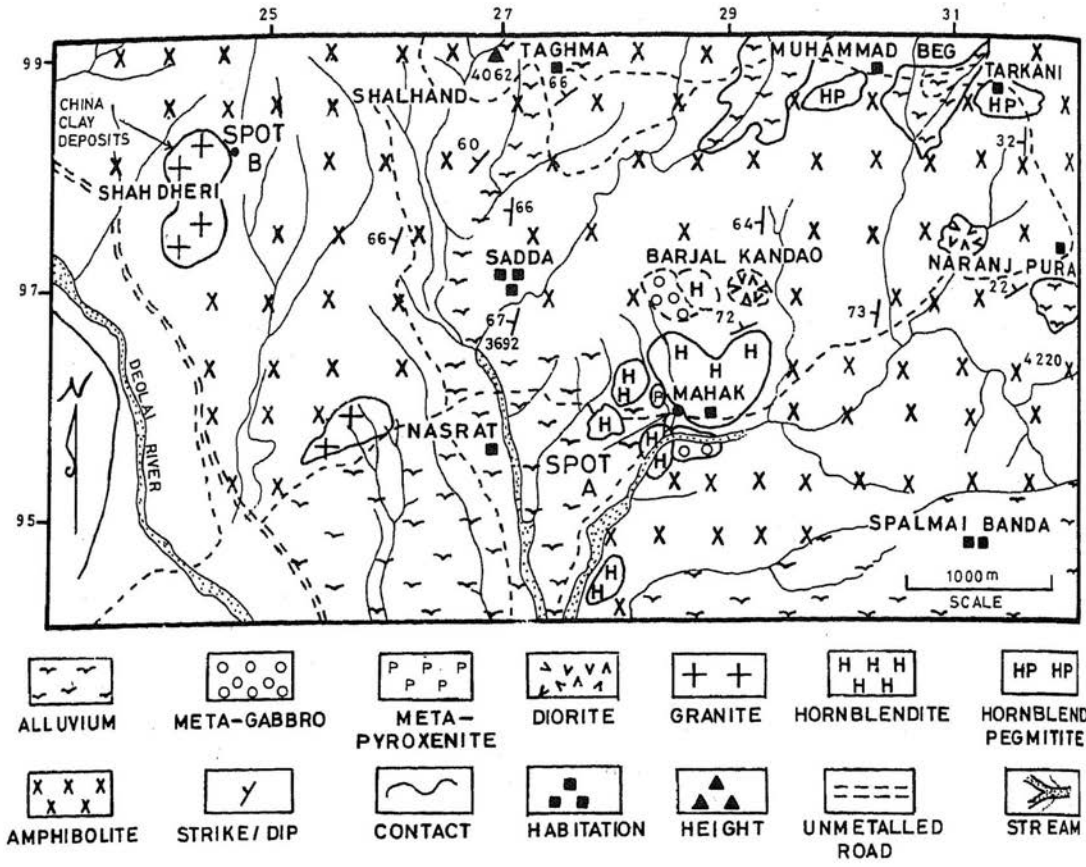

Fig. 1. Geological map of the Mahak and surrounding area (updated after Hamidullah et al., 1990).

bolite of the Mahak stream (cf. Fig. 1; also see Hamidullah et al., 1990, p40).

DISCUSSION

The various theories suggested by previous workers about the rocks of the Southern amphibolite belt regard amphibolite or epidote ampohibolite facies metamorphism as the dominant factor in producing the final product (see Ahmed, 1978; Khattak et al., 1985). Working in the southern amphibolite belt in general and around Mahak (Fig. 1) in particular for the past several years by one of the authors (SH) it has been realized that most of the so called amphibolites are not products solely of metamorphism. Rocks in the vicinities of the granitic bodies (or their off shoots) reveal clear evidences of hybridization by the granitic magma. In fact this phenomenon is noticed all over the southern amphibolite belt where granites intrude amphibolites, i.e. Shah Dheri, Nusrat, Mahak (Fig. 1), Sajban (~8.5km NNE of Fig. 1) and Peochar (~10km north of Fig. 1 and close to the northern contact of the southern amphibolite belt with the Chilas complex). These observations also show that small to large granitic bodies occur throughout the southern amphibolite belt in Swat Kohistan.

Therefore, it may seem a vague generalization, but where not seen, granitic magma may have probably not breached the present day surface and granites may be present at depth. A geophysical survey is needed to confirm it. This also indicates probably that most of the so called amphibolites are in fact "pseudo-amphibolites" or hybrids.

The scarcity of the syn-granitic hornblendites is probably due to their confinement to fine grained banded amphibolites which are relatively less common compared to the homogeneous and massive amphibolites and pre-granitic hornblendites.

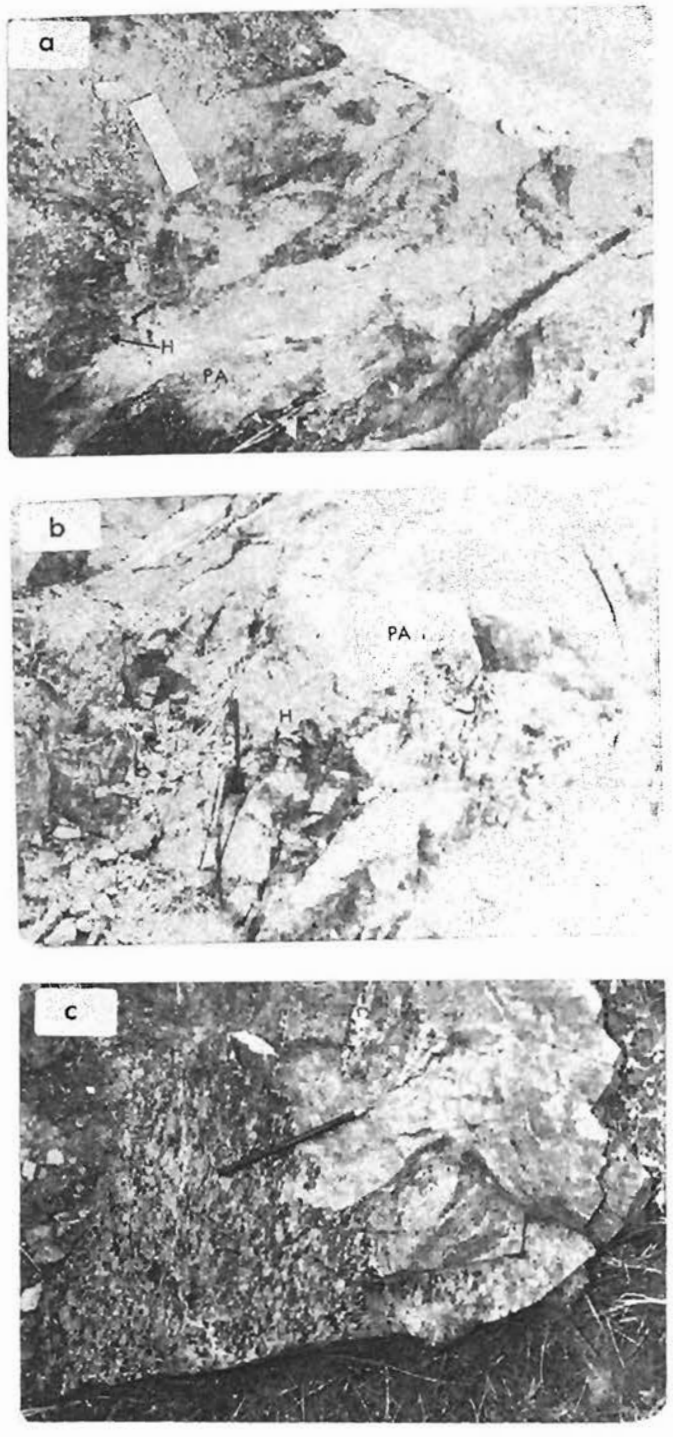

Fig. 2. Photographs showing:

a. granitic veins (top and middle) intruding hornblendite at Mahak (Spot-A in Fig. 1). Origional hornblendite (H; dark) and its transtional replacement to lighter hibrid/pseudo-amphibolite (PA) can be noticed.

b. Similar phenomenon as noticed in Fig. 2a. This type of transition is more common in the area.

c. Fine-granied banded amphibolte intruded by granitic veins at Shah Dheri (Spot-B in Fig. 1). Notice the growth of hornblende on the left but still retaining the the origional texture and colour of the hornblende-free rock on the right.

CONCLUSIONS

1. Most of the amphibolites around the granitic bodies in the southern amphibolite belt are hybrids and have formed as a result of interaction between pre-granitic hornblendites or amphibolites and the granitic magma.
2. Apart from pre-granitic hornblendites, post-granitic hornblendites also occur which have formed due to reaction between fine-grained banded amphibolites (metavolcanics?) and the granitic magma.

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