

## **EXTENSION OF SKHAKOT-QILA ULTRAMAFIC COMPLEX IN UTMAN KHEL, MOHMAND AGENCY, N.W.F.P., PAKISTAN.**

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### **ABSTRACT**

*The Utman Khel area in Mohmand Agency contains bodies of ultramafic and mafic rocks covering an area more than one third of that of the Utman Khel mountains. The ultramafic rocks are emplaced as klippe over the metasediments of Paleozoic age. The central part of the complex generally consists of massive dunite, peridotite, and grades outward into massive to friable serpentinites. At several places, dunite, peridotite, and serpentinite are altered to talc-carbonate and carbonate-quartz rock, particularly along shear zones. Steatite and blackwall-chlorite rock form small masses at the margins of the ultramafic rocks, adjacent to the contact with metasediments. Chromite occurs as podlike and lensoidal masses in 54 showings sporadically distributed over six different locations.*

*The characteristics displayed by the ultramafic rocks of the Utman Khel area are virtually similar to those displayed by the rocks of the Skhakot-Qila complex. Therefore it is appropriate to consider the ultramafic rocks of Utman Khel area as the extension of Skhakot-Qila Complex.*

### **INTRODUCTION**

The alpine-type Skhakot-Qila ultramafic complex was described by Asrarullah (1960), Ali and Amin (1963), Qaiser and others (1970), Uppal (1972, 1980), and Ahmed (1978, 1982). The present investigation shows that the complex extends west of Jindai Khwar in Mohmand for approximately 20 km. Small isolated bodies of the complex extend further west in Utman Khel area. Thus the entire complex covers an area of more than 225 km<sup>2</sup>. Malinconico (1982) has described it as a klippe over the Indian mass. This investigation is a part of a programme of mapping the chromite showings, and steatite- and emerald-bearing talc-carbonate rocks in the ultramafics of Utman Khel area.

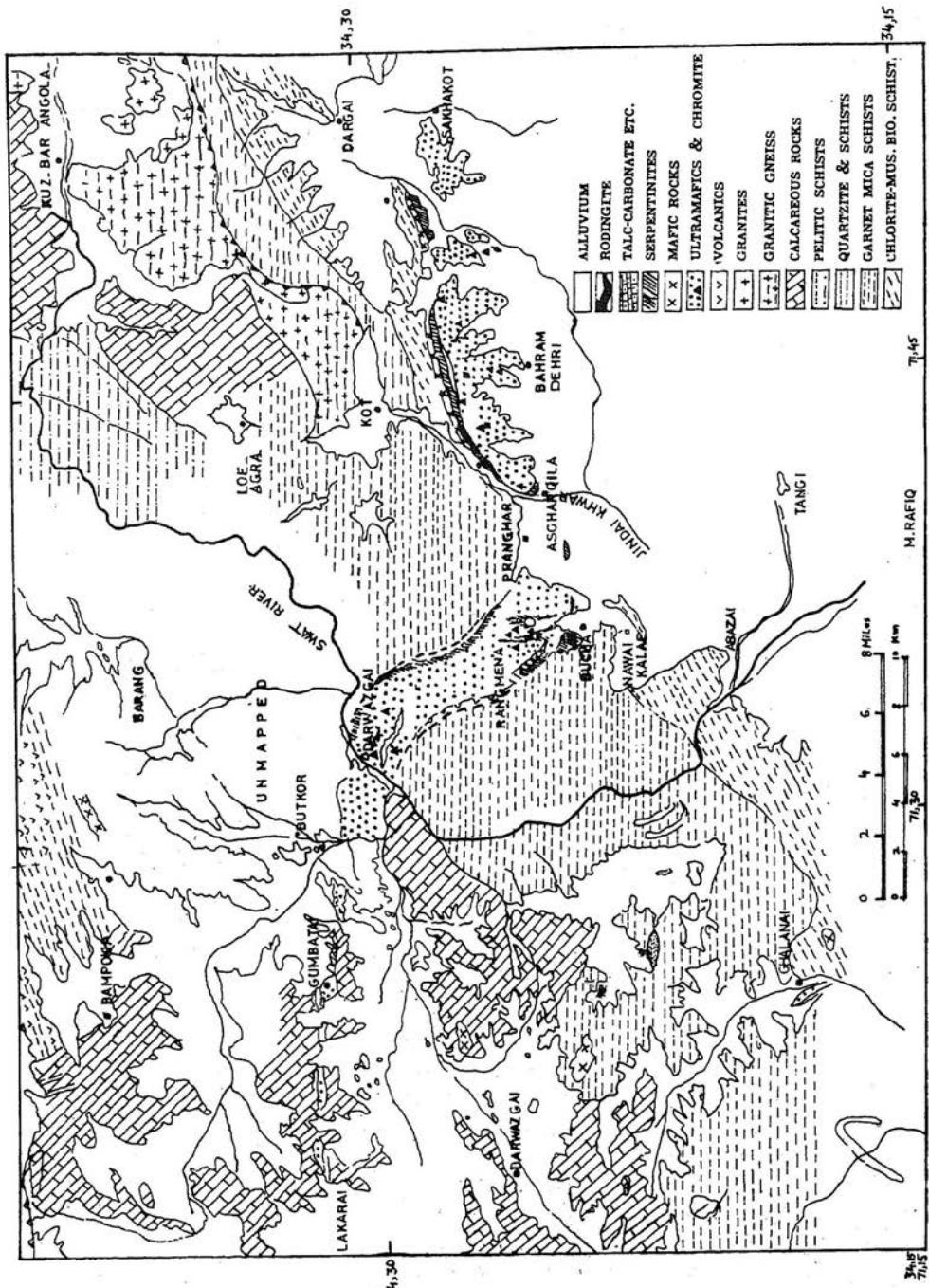


Fig. 1. Geological map of Skhakot-Qila-Utman Khel ultramafic complex, Malakand and Mohmand Agencies, N.W.F.P., Pakistan

## GEOLOGY OF THE AREA

The generalized geological map of the area (Fig. 1) shows the distribution of ultramafic rocks in Malakand and Mohmand Agencies. In the Skhakot-Qila area the complex extends in a ENE-WSW direction and in the eastern Mohmand area it trends NW-SE. Most of the sporadic outcrops of Utman Khel strike ENE-WSW to EW. The planer elements are predominantly vertical or dip steeply north. The northern and southern boundaries of the complex are marked by north-dipping thrusts. The main body of the ultramafic complex also contains shear zones.

Ultramafics and associated rocks constitute more than 30% of the Utman Khel mountain area. The ultramafic rocks in Skhakot-Qila area are relatively fresh, whereas those in the Utman Khel area west of Jindai Khwar are at places altered, especially along shear zones; serpentinite asbestos, tremolite rock, talc-carbonate rock, carbonate-quartz rock, steatite and chlorite wall-rock are found in the form of irregular to podlike, elongated or tabular masses and veins transecting the ultramafics. Irregular pods and lenses of chromitite and chromite-bearing dunite are concentrated in two linear zones. Dunite, peridotite, serpentinite and mafic rocks are the main rock types of the complex.

*Dunite and Peridotite:* In agreement with Uppal (1972) nearly two thirds of the ultramafic rocks of the complex are dunite and peridotite. Dunite with interlayered peridotite crops out extensively on the south-eastern slopes of the Utman Khel mountains. The transition from dunite to peridotite is gradational and both are variably serpentinized. Both the rocks locally display crude banding. These are fine to medium-grained and generally massive. The composition of the olivine in these rocks ranges from  $Fo_{88}$  to  $Fo_{92}$ . Most of the dunites contain 1 percent to 11 percent pyroxene, however, some are pyroxene free. Chromite and, possibly, magnetite range from traces to 5 percent. Serpentine, chlorite, carbonate and talc occur in traces. The peridotites contain 12 to 15 percent pyroxene. Samples Ut 12, Ut 15, Ut 23 and Bu 3 contain orthopyroxene, and can be classed as harzburgite, whereas Ut 5, Ut 6, Ut 8, and Ut 9A contain clinopyroxene and are classified as wehrlite (Table 1), chromite is present as traces. Serpentine (generally  $> 3\%$ ), limonite, chlorite, talc and carbonate are the secondary products. Talc and carbonates are common along the fractures and grain boundaries of olivine.

*Chromite:* Podiform chromite and chromite-bearing dunite pods in the ultramafic rocks are of particular importance. Two series of pods, lenses and sack-form bodies of chromite, are exposed conforming to the main trend of the ultramafics at 54 places within the Utman Khel area. The principle concentrations of chromite deposits are in Bucha and Rangmena at the southern foothill of Utman Khel mountains, in the southeastern part of Utman Khel at Balola, Balogai, Jau, Kawal, Bazargai, and west of Swat river in Mohmand Agency near Gumbatai and Lakarai.

The deposits of Bucha and Rangmena consist of 16 surface showings of chromite. The Bucha chromite is blackish brown in colour, mostly fine-grained and massive. The individual showings here are less than 10 sq. m. in surface

TABLE 1. MODAL COMPOSITION OF ULTRAMAFICS FROM UTMAN KHEL AREA (VISUAL ESTIMATES IN THIN SECTION).

Sp. No.	Rock Name	Olivine	Orthopyroxene	Clinopyroxene	Serpentine	Chlorite	Carbonate	Talc	Ore	Chromitite Magnete
Ut 5	Wehrlite	82	1	12	2	1	Tr	1	Tr	
Ut-6	Wehrlite	85	1.5	11	2	1.5	Tr	1.5	Tr	
Ut-8	Wehrlite	82	1	11	4	Tr	Tr	1.5	2	
Ut-9A	Wehrlite	83	2	13	Tr	Tr	Tr	Tr	1.5	
Ut-11	Harzburgite	88	8	2	Tr	—	—	1	1	
Ut-12	Harzburgite	82	9	4	2	1	—	1	Tr	
Ut-15	Harzburgite	84	6.5	2	6	2	—	—	—	
Ut-23	Harzburgite	89	8	1	2	—	Tr	—	—	
95	Bu-3	85	8.5	3	1	—	—	—	—	Tr
	Bu-1	Dunite	96	1	1	Tr	—	—	—	2
	Bu-4	Dunite	99	Tr	—	—	—	—	—	Tr
	Bu-16	Dunite	91	1	—	4	Tr	—	—	3
	Bu-7	Dunite	97	Tr	—	3	Tr	—	—	Tr
	Ut 6	Dunite	93	Tr	—	3	—	—	—	2
	Ut 1	Dunite	93	2	Tr	4	—	—	—	1
	Bu-2	Serpentinite	7	5	Tr	85	1	1	Tr	—
	Bu-20	Serpentinite	3	1	—	91	2	Tr	2	Tr
Bu-6	Serpentinite	1	6	2	89	2	Tr	—	1	
Ut-2	Serpentinite	4	Tr	Tr	95	1	—	—	—	Tr

area, however their  $\text{Cr}_2\text{O}_3$  content ranges from 46 to 50% (Table 2) and their  $\text{Cr}_2\text{O}_3/\text{FeO}$  ratio is nearly 5:1. The Rangmena deposits are fine to medium-grained and massive. The deposits range from sparsely disseminated chromite to dense podlike masses with a concentration of 41%  $\text{Cr}_2\text{O}_3$ , with a  $\text{Cr}_2\text{O}_3/\text{FeO}$  ratio of 4:1. The disseminated chromite deposits at Rangmena form low grade deposits.

The chromite deposits occurring in Balola and Balogai are lenticular and podlike bodies. Dissiminated ore in dunite is common, however, massive chromite occurs at the foothills of Balogai village. Surface exposures of all these showings are small in size, but the content of  $\text{Cr}_2\text{O}_3$  varies from 31% in disseminated ore to 38% in massive ores.

Concordant podiform and lenticular bodies of chromite and disseminated chromite in ultramafic rocks are exposed on the north-western slopes of Utman Khel mountain east of Swat River. Seventeen surface showings occur near Kawal, Jau, Bazargai, Kotagai and Mera. The chromites of these areas are fine to medium-grained. The Bazargai chromite is coarser, the ore contains rounded to ellipsoidal grains of up to 3 mm size (pique ore). Nearly 2000 tons of ore were exploited by the locals during 1981. Selected samples were analysed for  $\text{Cr}_2\text{O}_3$  and  $\text{FeO}$ . The  $\text{Cr}_2\text{O}_3$  content ranges from 13.38% to 31.11% in disseminated ore, while that of massive ranges from 33% to 42%. The  $\text{Cr}_2\text{O}_3/\text{FeO}$  ratio is nearly 3:1.

The deposits of Gumbatai and Lakarai west of Swat River are of importance. The general occurrence of the chromite here is similar to that described for other areas. The chromite deposits of Gumbatai are of special interest because the dense ore contains more than 42% of  $\text{Cr}_2\text{O}_3$ . These deposits are not so extensive on the surface, but require subsurface investigations.

TABLE 2. REPRESENTATIVE CHROMITE ANALYSES FROM SAMPLES SHOWING DENSE AND DISSEMINATED TEXTURES.

Location	No.	Dense Ore			Disseminated Ore			
		$\text{Cr}_2\text{O}_3$	$\text{Cr}_2\text{O}_3$	$\text{FeO}$	$\text{Fe}_2\text{O}_3$	$\text{Fe}_2\text{O}_3$	$\text{FeO}$	
Bucha	H55	50.10	3.25	8.82	—	—	—	
	H56	48.30	3.80	8.90	—	—	—	
	H57	46.70	3.90	8.50	—	—	—	
Rangmena	H58	41.30	2.35	10.68	H59	11.29	2.65	
Balogai	H72	42.70	2.00	12.88	H73	16.85	2.55	
Kawal	H78	39.00	4.80	8.9 <sup>+</sup>	H79	26.75	3.44	
Balola	H100	38.00	4.66	12.70	H101	21.15	2.32	
Bazargai	H120	36.60	3.40	11.53	H121	13.38	2.48	
Kotagai	H125	33.90	4.35	11.25	H126	25.77	2.40	
	H130	35.30	4.00	9.9 <sup>+</sup>	H131	31.11	2.95	
Jau	H132	38.45	2.76	9.10	H133	14.37	1.98	
Gumbatai	H150	50.15	2.76	6.98	—	—	—	
	H151	52.10	2.40	10.70	—	—	—	
	H152	47.30	3.20	10.10	—	—	—	

*Serpentinite:* Serpentinites can broadly be grouped as massive and friable types. In several places, the friable types surround the massive.

Massive serpentinite, green to black, is present throughout the area but is best exposed near Balola. It retains the gross textural features of the ultramafic rocks, but break with a hackly rather than grainy fracture. Relict olivine is commonly present, whereas, magnetite and chromite occur as fine to dust-like particles. Patches and veins of brucite and chlorite are common in these rocks.

Friable serpentinite is similar in colour to massive serpentinite, but it retains none of the textural features of the igneous rocks. It mainly contains serpentine, while magnetite, chromite and carbonate as accessory minerals, Brucite, chlorite and talc are sparse accessories.

Modal composition of both serpentinite is given in Table 1. Gradational relation, preservation of textural features, pseudomorphs after olivine, pyroxene, and chromite show that the serpentinite were formed by the alteration of ultramafic rocks. Serpentine also occurs as slip-fibre veins along shear zones (cf. Chidester et al., 1981) and cross fibre veins. These veins vary in thickness from less than 1 mm to 3 cm.

*Mafic Rocks:* Gabbroic rocks are associated with the ultramafic bodies and may show gradational contacts. The rocks are well exposed near Rangmena, Kawal, Kotagai, Gumbatai and Lakarai in Mohmand Agency. These consist of plagioclase ( $An_{65-73}$ ) 50–60%, clinopyroxene 15–20%, orthopyroxenes 5–8%, epidote 3–5%, biotite 1–4% and upto 2% ore.

*Steatite, Talc-Carbonate and Carbonate-Quartz Rocks:* These rocks are associated with the ultramafic bodies as irregular and lenticular masses, and their distribution is dominantly controlled by shear zones. Steatite and talc-carbonate rocks are well-exposed in the western part of the ultramafic complex near Bucha, Balola and Rangmena, whereas the carbonate-Quartz rock is exposed near Qila and some small outcrops were located near Kawal, Kotagai and Jau area.

*Steatite:* It forms thin lenticular masses, a few centimeters to a meter thick along the outer margin of the ultramafic complex near Bucha village. The rock is fine-grained and schistose in texture but at places it is massive. It is grey to light greenish grey and consists of shreds and flakes of talc (92%), tremolite (3–5%), chlorite (1–3%), and ore.

*Talc-Carbonate Rocks:* These irregular masses near Bucha extend upto Kawal village and consist of a fine-grained ground mass of talc. The rock is whitish to greenish grey with rusty brown spots. The composition varies, but generally it contain talc 60% and carbonate 40% in thin sections. Dusty ore minerals, chlorite and locally emerald occur as accessories.

*Carbonate-Quartz Rocks:* These rocks are fine- to coarse-grained, massive and grey to rusty brown on weathered surfaces. When fresh, the rocks are light grey to

whitish green in colour. These consist of about (80%) carbonate and quartz (15%). Opaque oxides (relict chromite and secondary magnetite), shreds of talc and chlorite are the accessories.

*Blackwall Chlorite Rock:* This rock type is well exposed east of Rangmena village and borders the ultramafic complex. It is typically dark green and fine grained. It consists essentially of chlorite and crystals of magnetite, with a poor to good schistosity.

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