MANTLE PROCESSES AS DEDUCED FROM ALPINE ULTRAMAFICS

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INTRODUCTION

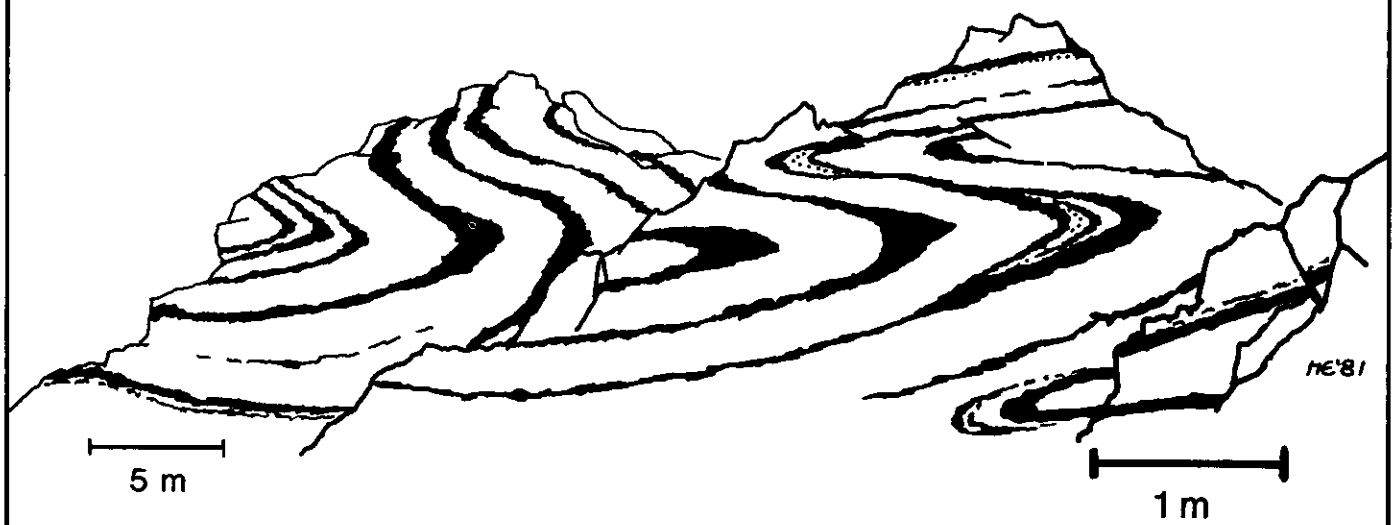
This study of mantle processes, as deduced from alpine ultramafics, has been initiated in the hope that some positive statements may be made concerning the predictability and conditions of occurrences of chromite deposits within British Columbia. Several well-exposed alpine ultramafic bodies have been chosen for study. They are all within Upper Paleozoic rocks and thus may be slices of the same original mantle material that have since been welded to the craton.

Interpretation of conditions of equilibrium and deformation processes depend upon accurate determination of geothermometry and geobarometry of the constituent phases. Methods for calculation of these conditions are based upon calibrated exchange equilibria among olivine, pyroxene(s), and spinel. These require accurate probe analyses of fresh material. Thus, we have examined three alpine ultramafic bodies whose rock type distribution has been mapped previously in some detail. These are the Bridge River ultramafic (Wright, 1974), the northern end of the Shulaps ultramafic complex (Leech, 1953), and the Blue River ultramafic (Wolfe, 1965) north of Cassiar.

GENERAL DESCRIPTION

These ultramafics were chosen because they reportedly lack or have only a moderate degree of serpentinization. Complete structural sections were mapped across each of the bodies and samples collected for thin section and probe analysis.

At this time, preliminary examination of thin sections indicates that the Bridge River and Shulaps ultramafics are remarkably similar. Both are composed essentially of harzburgite with interlaminated dunite and very minor websterite and wehrlite. Where they are interdigitated, dunite and harzburgite are present in almost equal proportions and individual layers vary in thickness from a few centimetres to several metres. Macroscopic layering defined by complex interdigitations of harzburgite and dunite is the earliest recognizable structure, and in some instances it is possible to infer the original facing direction of crystallization. At several localities this layering is involved in tight folds, some near isoclinal. These folds are on the outcrop scale (Figure 1) and in many instances elongate orthopyroxenes outline a foliation that is locally parallel to their axial surfaces.



Field sketch (perspective view):

Dunitic and pyroxenitic bands outline tight to isoclinal folds in harzburgite. Locality: Pioneer ultramafic body, NW side of ridge crest at coord. 5619.180m/516.620m/7250ft.
50° 43' 35" N / 122° 45' 52" W

Figure 1. Field sketch.

On a regional scale, the layering and orthopyroxene foliation are folded into broad open structures with angles between their limbs of approximately 60 degrees and whose axes appear to be coaxial with those of the earlier tight folds. Near the core regions of these open folds elongate orthopyroxenes are very well aligned parallel with the axial surfaces of these later folds.

It is frequently observed that small stringers of orthopyroxene and dunite also parallel the axial surfaces of the two fold sets, whereas chromite, where present in any concentration, appears aligned only with the earliest fold set elements.

The general petrographic and early structural character of the Blue River ultramafic appears to be similar to that just described. Owing to subsequent intrusion of the Cassiar Batholith (Wolfe, 1965), however, there are notable differences in later development. The northern portion of this ultramafic body, as well as adjacent sedimentary rocks and andesites, are thoroughly contact-metamorphosed by the batholith and locally display a series of clearly defined isograds. These have been mapped along several structural traverses. Within the contact aureole pervasive recrystallization partly destroyed mesoscopic structural elements and obliterated microscopic features. The southern part of the body, however, provides some material that can be directly compared to specimens from the other two bodies. However, serpentinization is much more intense here and outcrop conditions are generally poorer.

OUTLINE OF LABORATORY INVESTIGATIONS

The sample material collected this summer is presently being examined petrographically, specifically with the aim of identifying sections most suitable for geothermometric and -barometric work and for microstructural characterization. The extent and detail of these further studies will depend to a large degree on the consistency of the picture emerging. Particular questions we hope to answer include the following:

(1) What were the physico-chemical and rheologic conditions of (de-) formation of the mantle assemblages and mineral fabric?
(2) How did the crustal emplacement affect these conditions and what conditions prevailed during and after emplacement?
(3) What controls the occurrence, abundance, and composition of chromite (as pods, stringers, or in disseminated form) in these ultramafics?

ACKNOWLEDGMENTS

Peter van der Heyden and Michiel Dronkert provided able and cheerful assistance. Brian Cranston prepared the thin sections. John Watkins and Doug Whalen (Canadian Superior Exploration Ltd.) offered free helicopter support at Blue River.

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