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**STRUCTURAL GEOLOGY OF THE JOSEPHINE PERIDOTITE, NORTHERN  
CALIFORNIA: IMPLICATIONS FOR STRUCTURAL PROCESSES AT SLOW  
SPREADING CENTERS**

by

Gregory Thomas Norrell

A Dissertation

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Doctor of Philosophy

College of Science and Mathematics

Department of Geological Sciences

1989

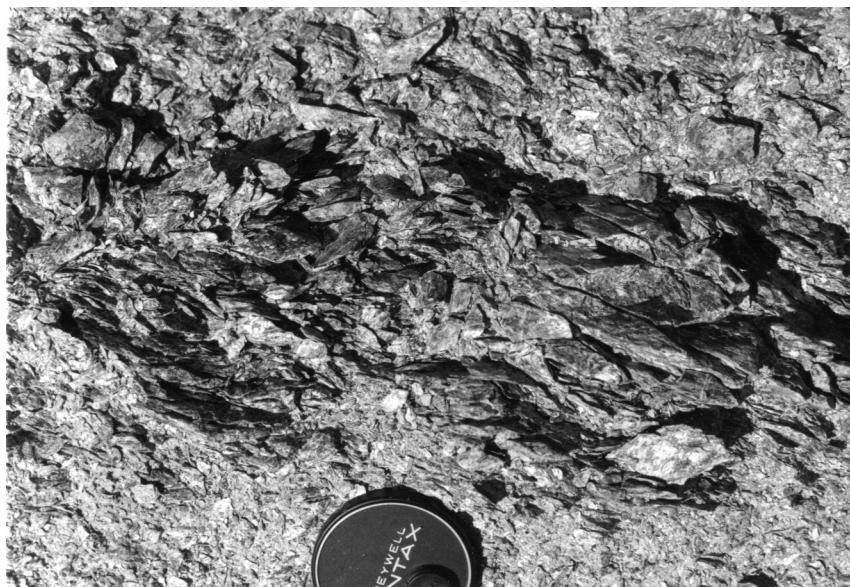


Fig. 3.3. Incohesive sheared serpentinite with a disjunctive, anastomosing cleavage.  
Most sheared serpentinites in ophiolites are of this type.



Fig. 3.4. Foliated cataclasite from shear zone along the northeast side of High Divide. Clasts of many sizes are present within the well foliated matrix. Cleavage surfaces often possess slickenlines from asperity ploughing.

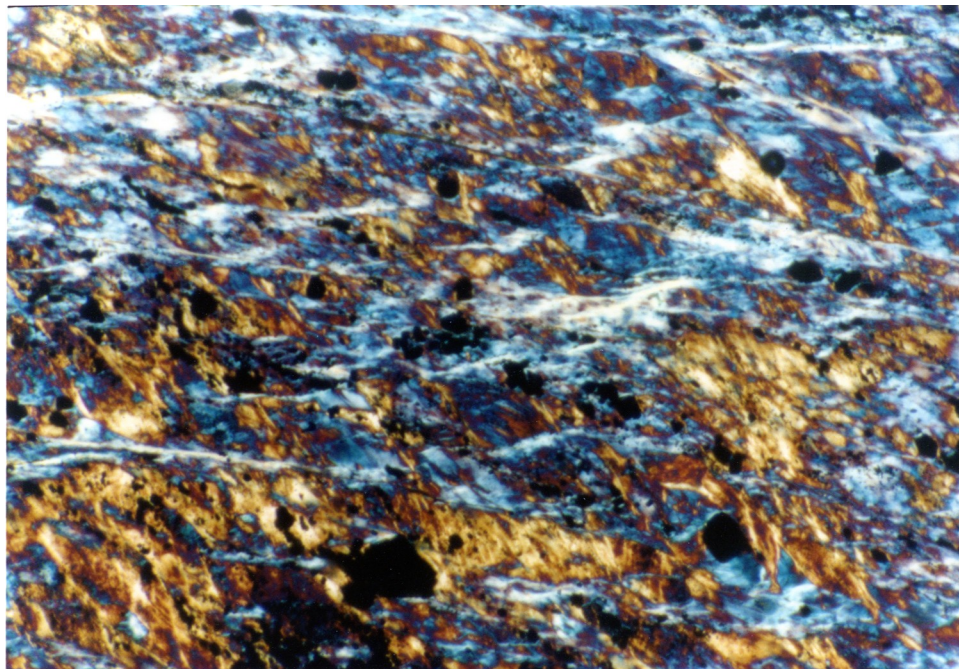


Fig. 3.5. Photomicrograph of incohesive serpentinite (SC-8181) with gypsum plate inserted. Photo is ~3 mm across. See text for discussion.

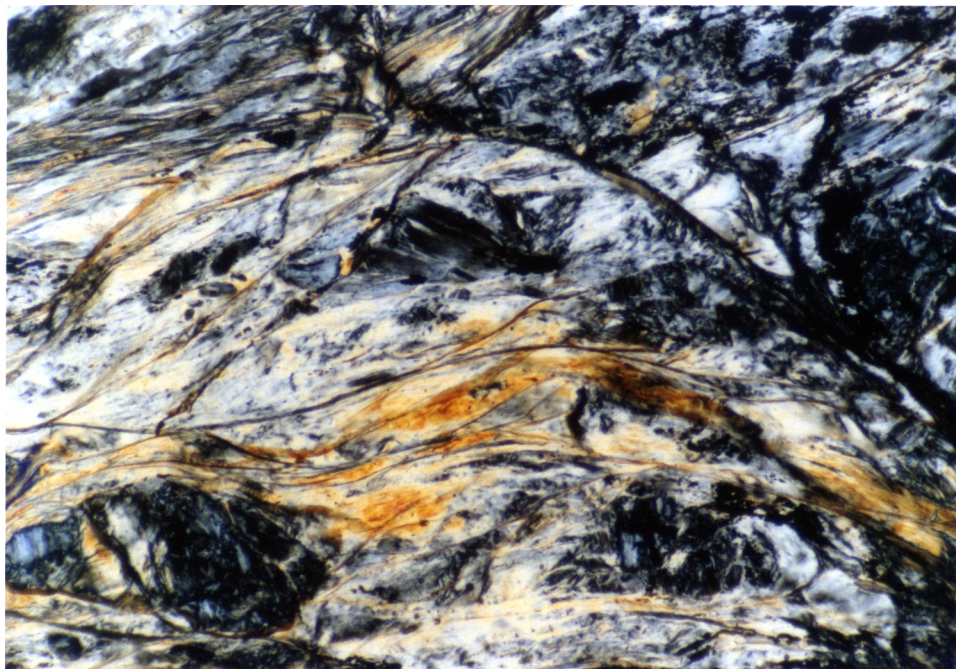


Fig. 3.6. Photomicrograph of incohesive serpentinite (SC-8125) under crossed polars. Note anastomosing fractures. Photo is ~ 3 mm across.

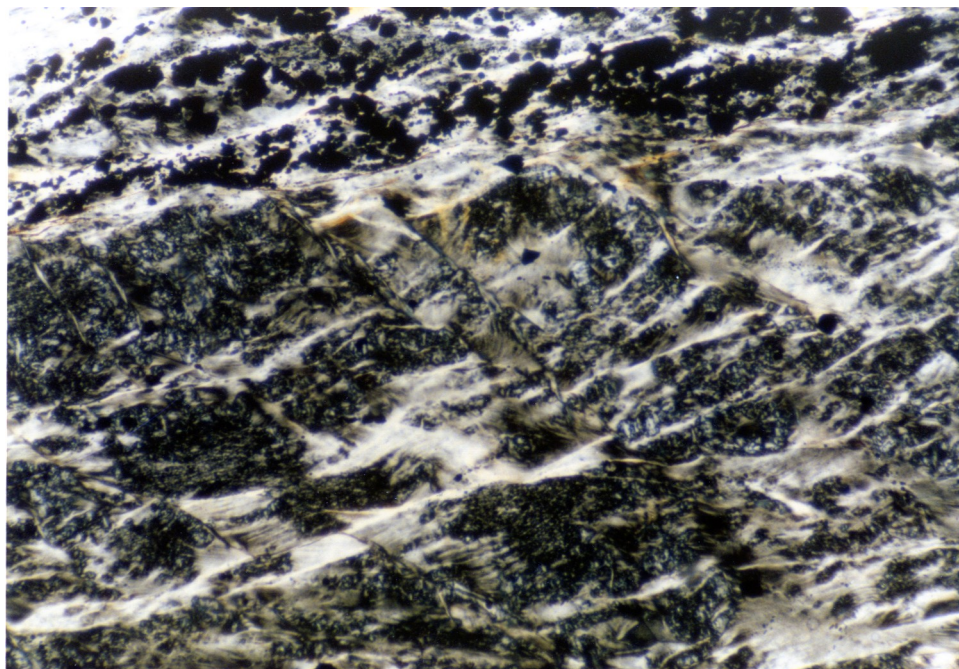
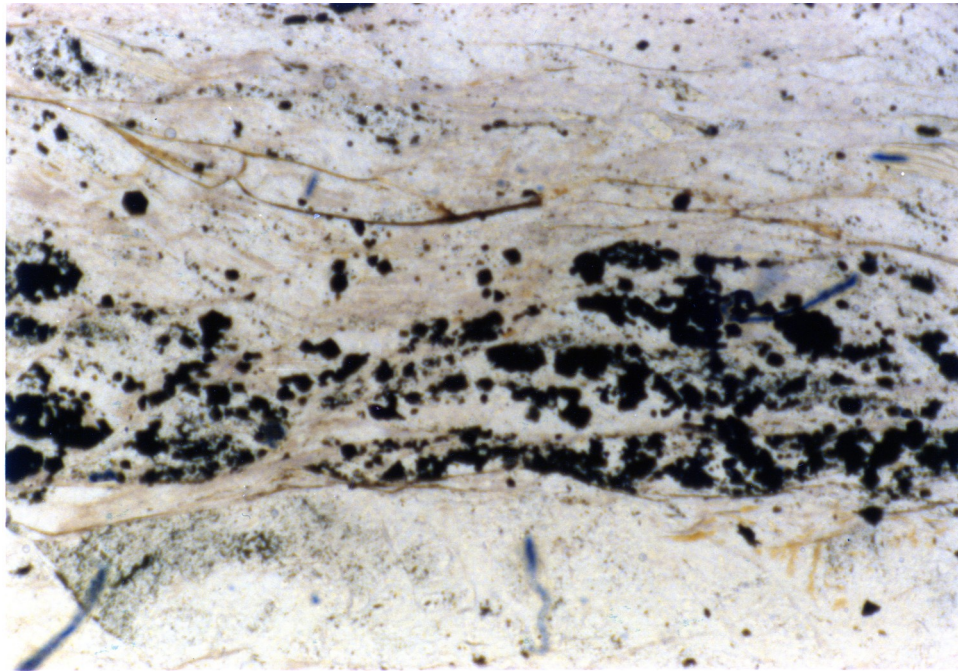


Fig. 3.7. Photomicrograph of incohesive serpentinite (SC-8151) under crossed polars. Fractures are present, some of which have serpentinite aligned parallel to them. Domains of undeformed serpentinite are also present. Photo is ~3 mm across.

### Incohesive Serpentinite



### Serpentinite Mylonite

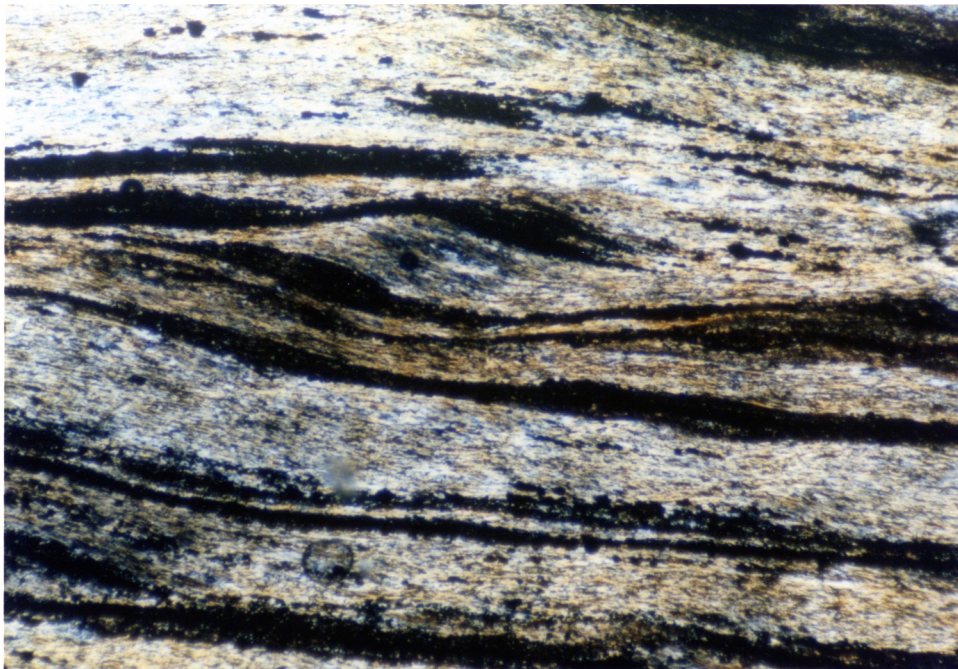


Fig. 3.8. Comparison of development of compositional banding in incohesive serpentinites versus serpentinite mylonites. Top photo is a typical incohesive serpentinite (plane light) with a weak segregation of magnetite into layers. Bottom photo is a typical serpentinite mylonite (crossed polars) with a well defined compositional banding. Both photos are ~3 mm across.

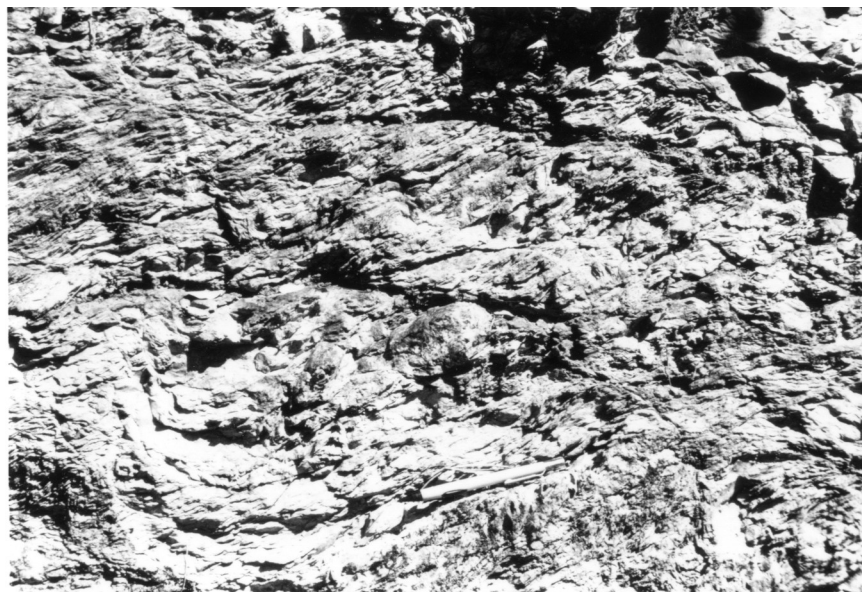


Fig. 3.9. Possible *P-Y* tectonite fabric present in cataclastically deformed, incohesive serpentinite. *Y*-surfaces are horizontal while the more penetrative *P*-foliation is inclined towards the right. Geometry suggests a dextral shear sense.





Fig. 3.10. Fibrous slickensided fracture surface with steps. Geometry suggests the missing block moved to the left.



Fig. 3.12. Close up of fracture sets in Rattlesnake Slide shear zone. See text for discussion.

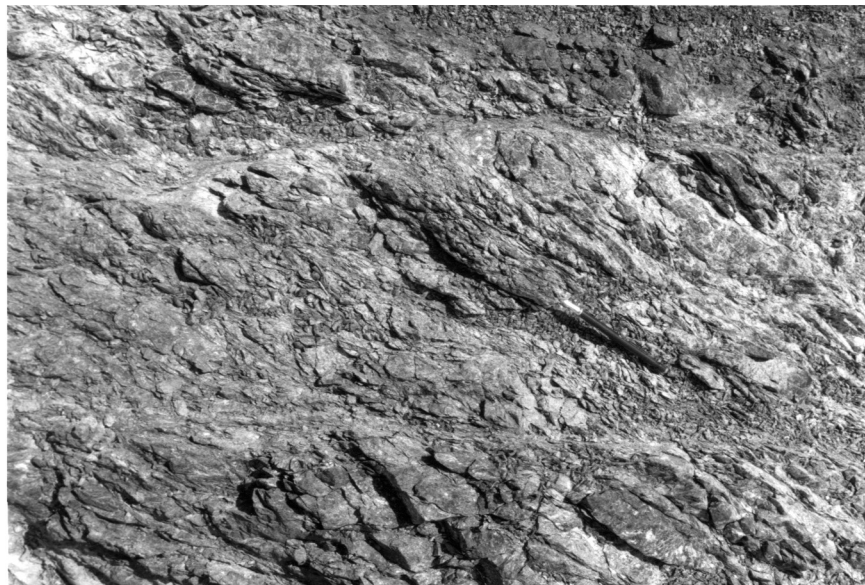


Fig. 3.14. Well developed probable  $P$ - $Y$  fabric in small talc shear zone portion of the Rattlesnake Slide shear zone. See text for discussion.

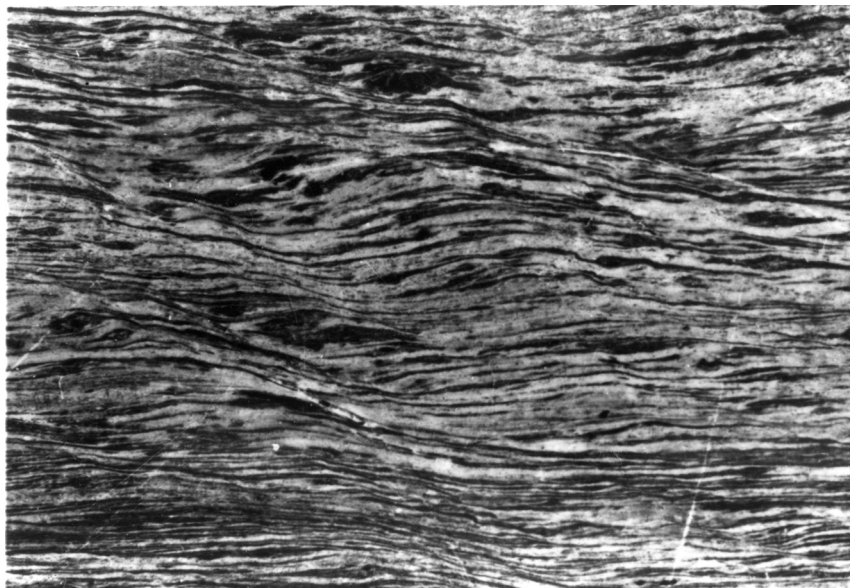


Fig. 4.1. Polished serpentinite mylonite. Face is cut normal to the foliation and parallel to the stretching lineation. The parallel compositional banding / grain-shape foliation (*CS*) is horizontal and is offset by a d-type oblique shear band foliation (dipping to the right). Shear sense is dextral. Photo is ~4 cm across.

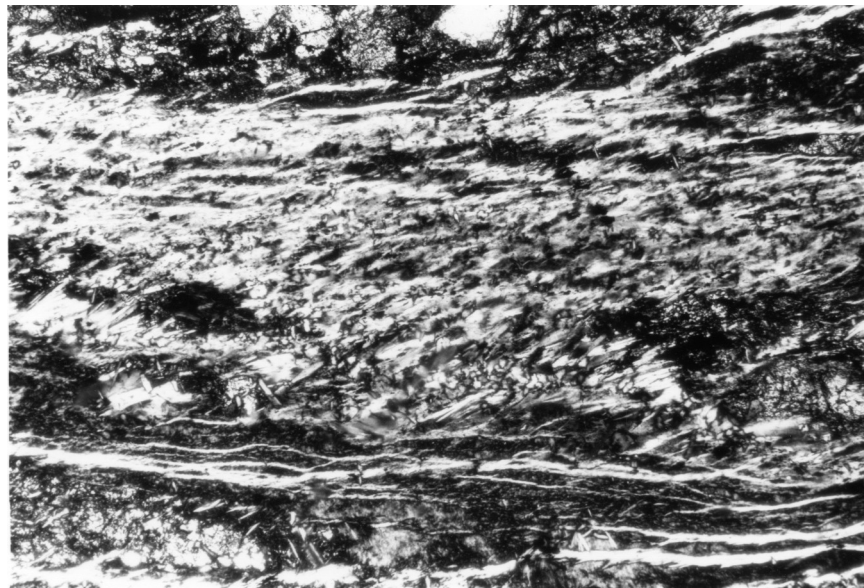


Fig. 4.2. Photomicrograph of a serpentinite mylonite from near the border of a plastic shear zone. A distinct, antigorite grain-shape foliation (*S*) is oblique to the compositional banding and to micro-shears (*C*). Shear sense is dextral. Photo is ~4 mm across.

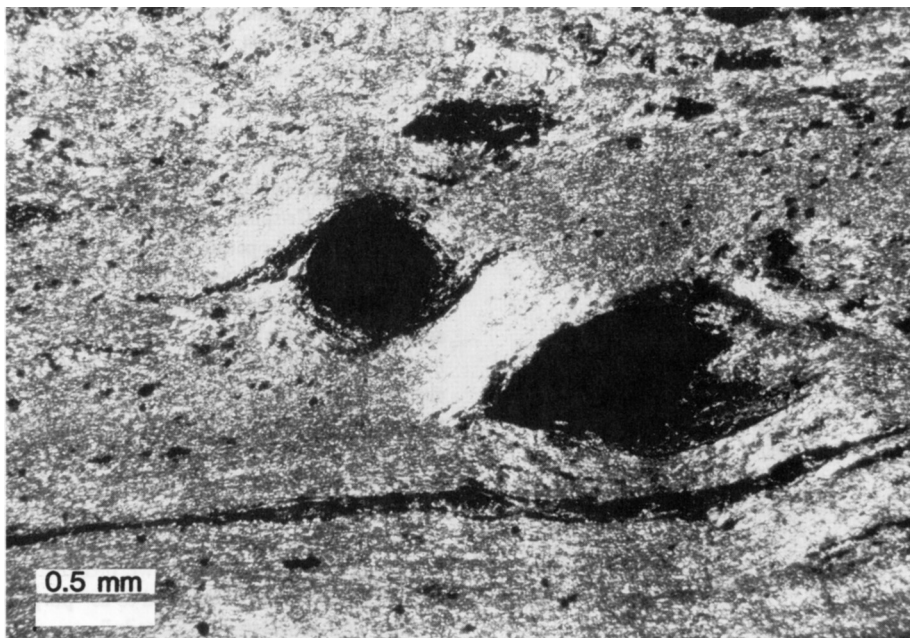


Fig. 4.5. Photomicrograph of serpentinite mylonite with a  $\delta$ -type porphyroblast. Shear sense is dextral.

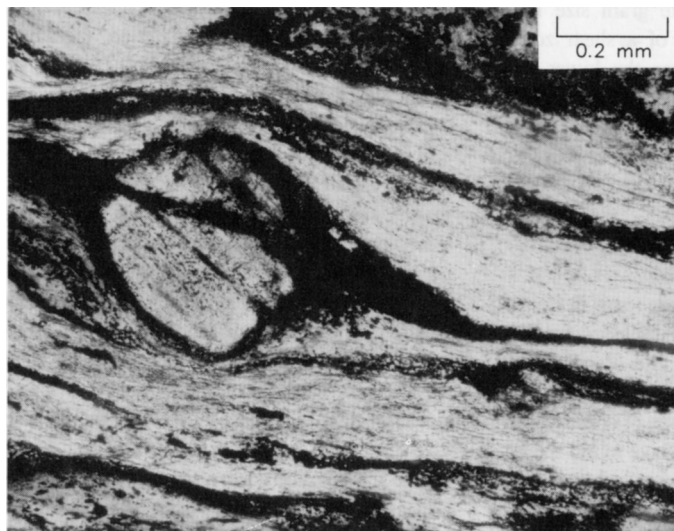


Fig. 4.6. Photomicrograph of a porphyroblast with a neocrystallization tail. Core is composed of a pre-alteration phase (pyroxene) while the tail is composed of a product of the serpentinization (magnetite).

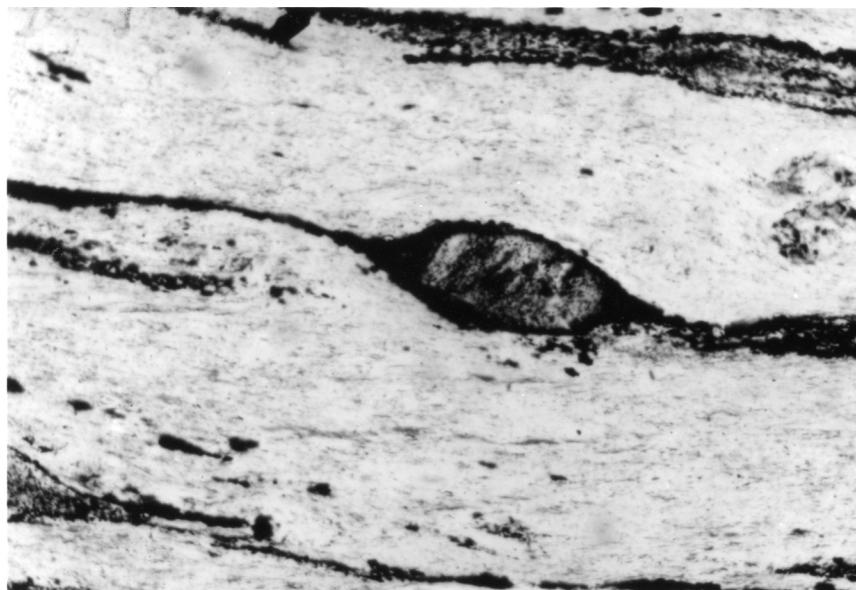


Fig. 4.7. Photomicrograph of a  $\delta$ -type porphyroblast with a pyrogenetic mineral comprising the core and neocrystallized material comprising the mantle and tails. Photo is ~2.5 mm across.



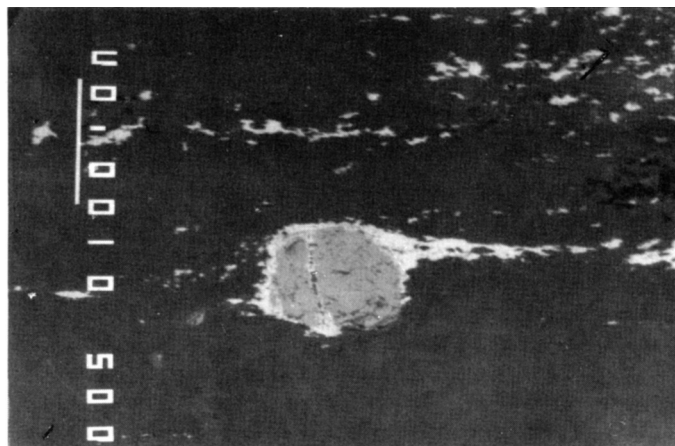


Fig. 4.8. Backscattered SEM image of a  $\sigma$ -type opaque porphyroblast system. Darkest material (matrix) is antigorite. Core is Cr-spinel (intermediate shade) while mantle and tail (lighter shade) is magnetite. Shear sense is dextral. Scale bar at left is 0.5 mm.

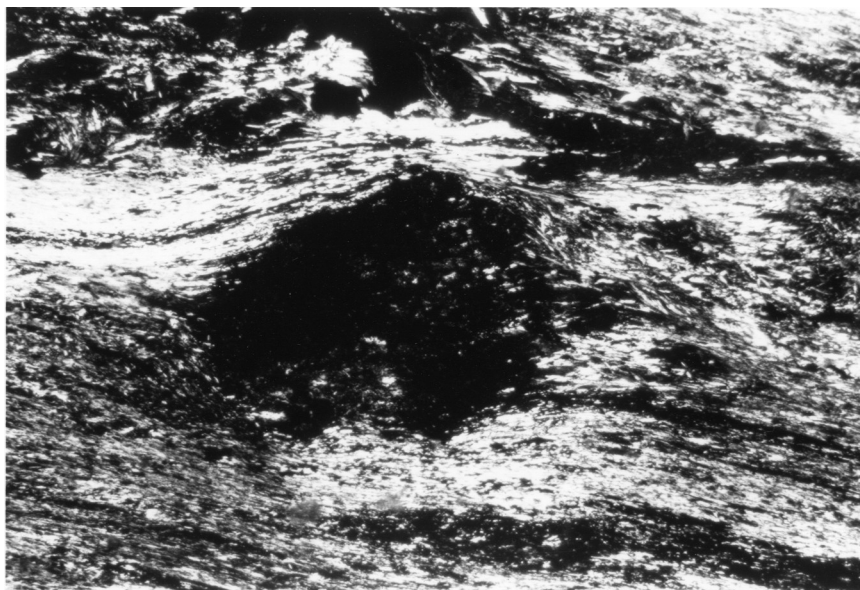


Fig. 4.9. Porphyroblast of altered pyroxene porphyroblast (1 mm in diameter). This type often possesses asymmetric "pile ups" of serpentine on edges where serpentine flowed toward the porphyroblast.

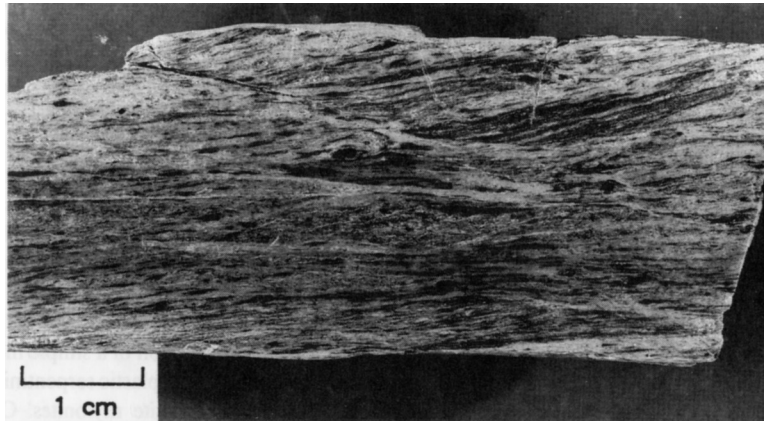


Fig. 4.12. Polished face of serpentinite mylonite cut normal to the foliation and parallel to the stretching lineation. F-type shear band dips to the right suggesting a dextral shear sense.

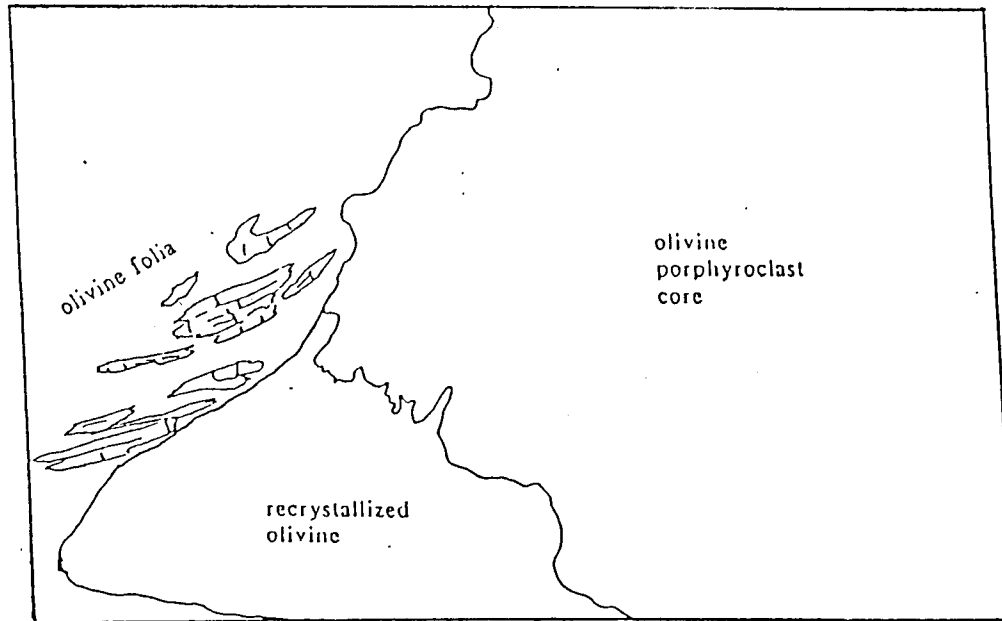
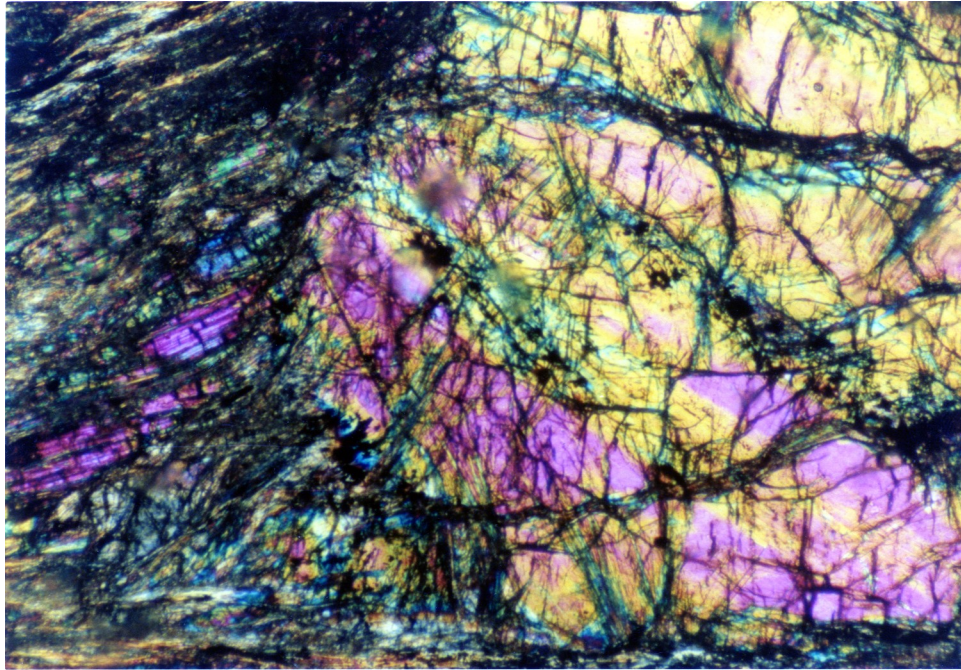


Fig. 5.2. Olivine porphyroclast with small recrystallized tail. Recrystallized olivine is mostly serpentinized. Photo is ~1.5 mm across.

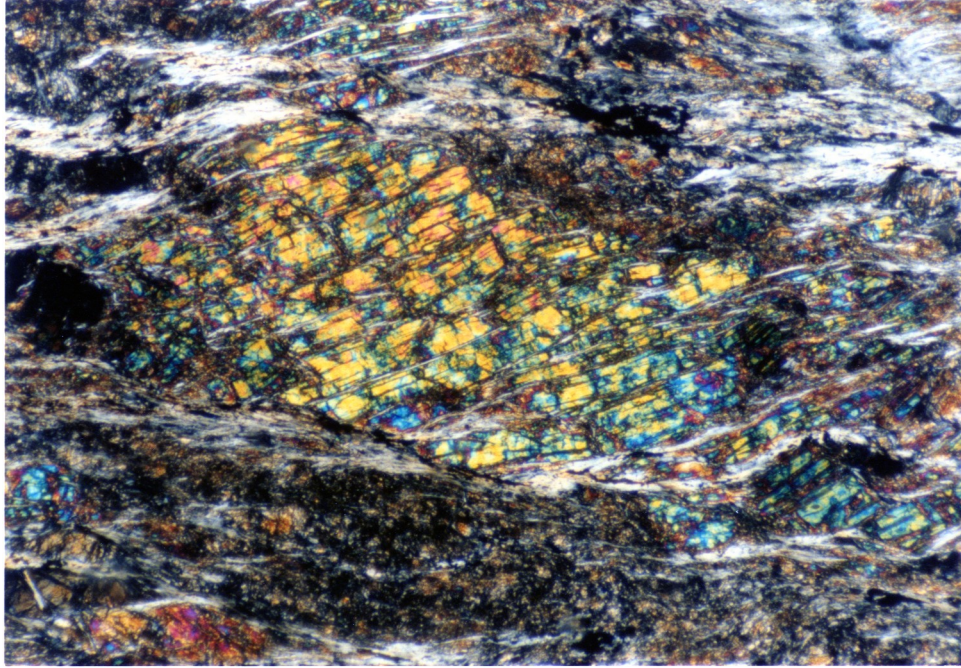


Fig. 5.3. Olivine grain with parallel fractures producing olivine folia. See text for discussion. Photo is ~3 mm across.

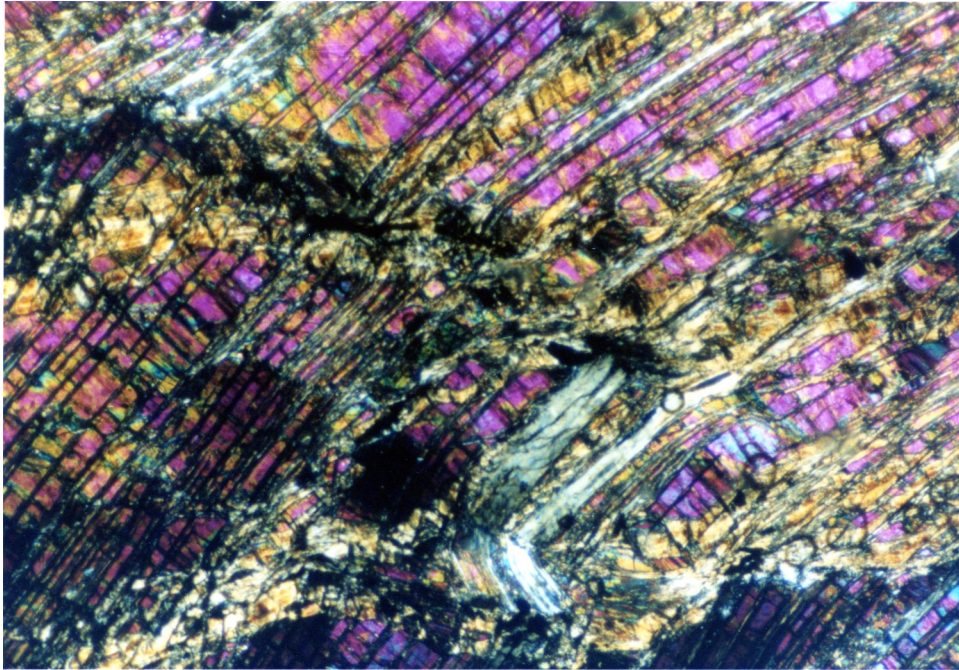


Fig. 5.4. Close up view of olivine folia. Serpentine is often present along the fractures. See text for discussion. Photo is ~1.5 mm across.

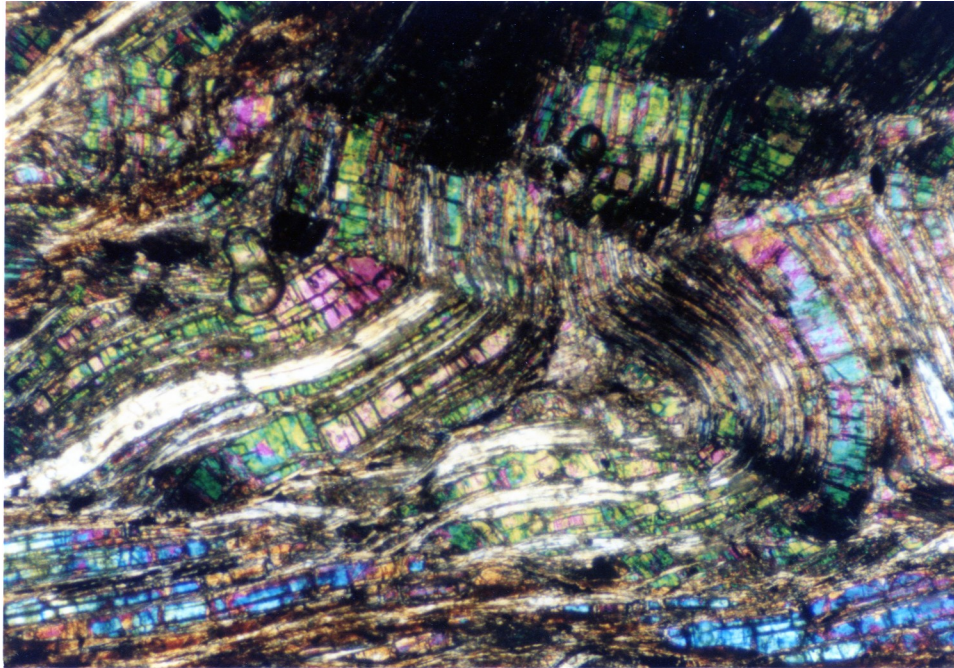


Fig. 5.5. Folded olivine folia. Fractures transect the folia which have probably accommodated the folding without significant olivine intracrystalline plasticity.

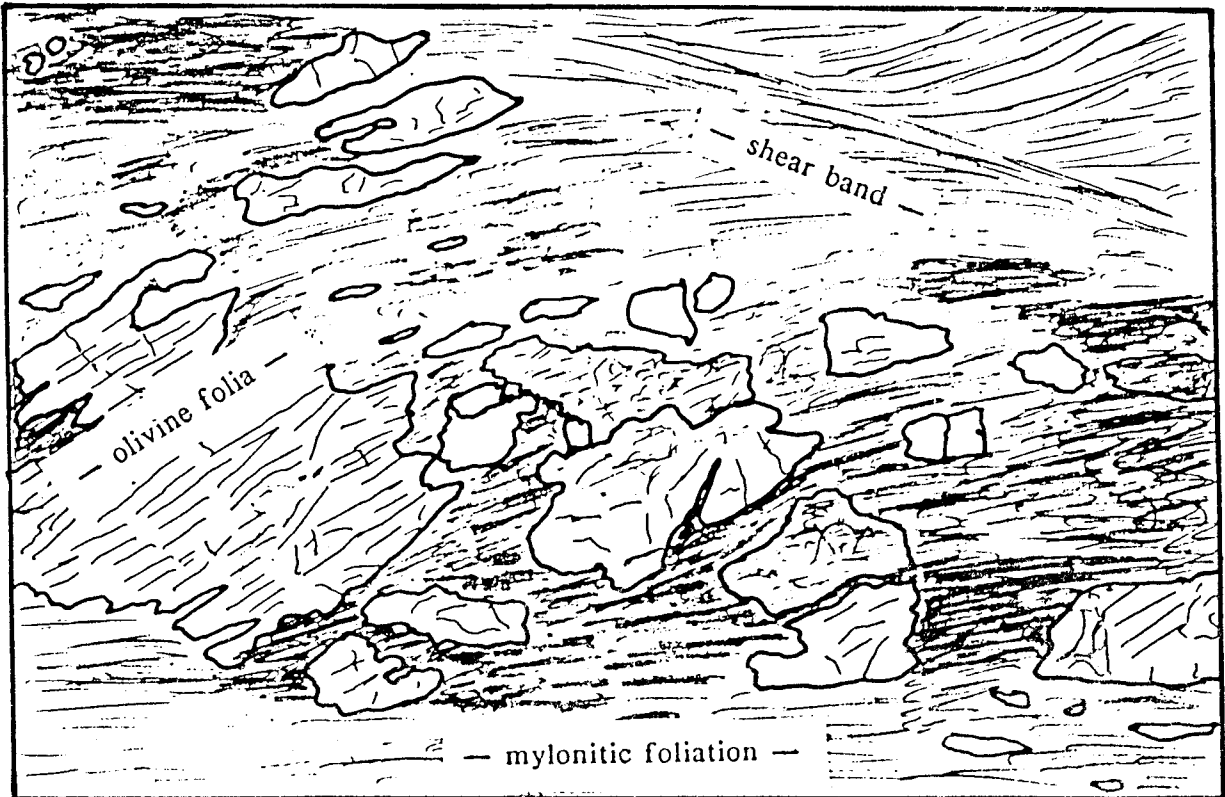
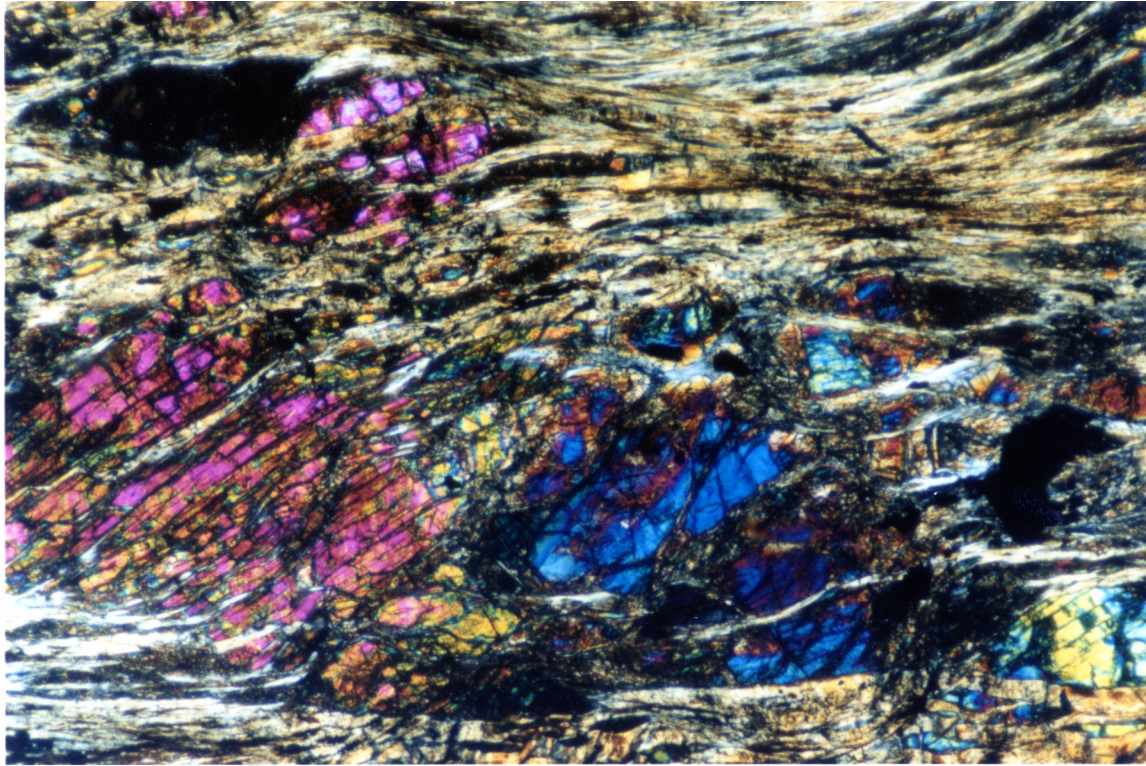


Fig. 5.6. Photomicrograph of peridotite mylonite with inclined olivine folia and a d-type shear band in a serpentinized zone. Shear sense is probably dextral. Photo is ~3 mm across.



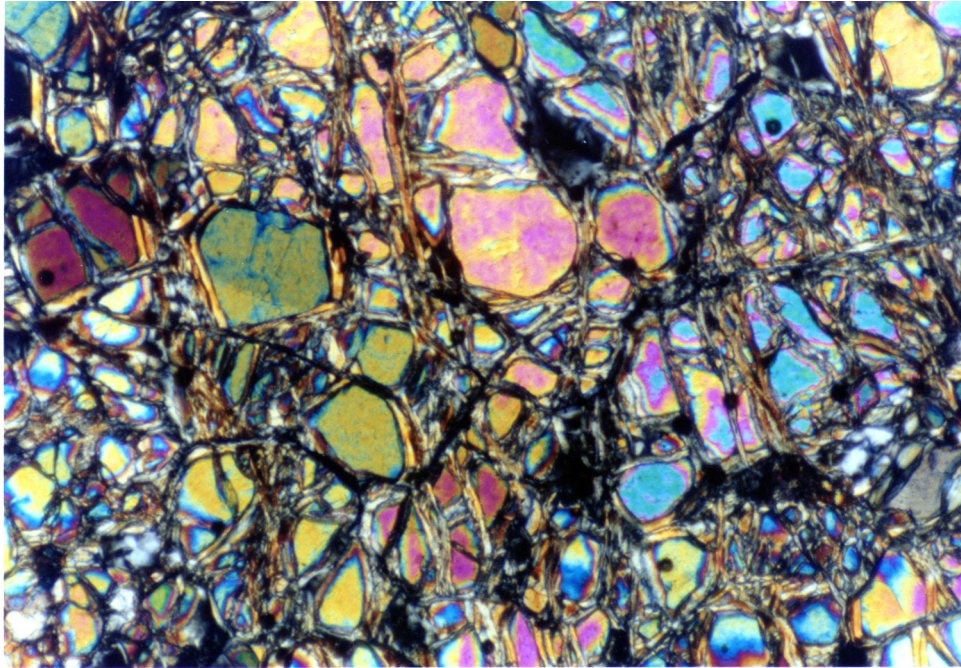


Fig. 5.11. Photomicrograph of typical harzburgite (HP-30) from Josephine Peridotite with coarse-equant texture. Small serpentine veinlets are ubiquitous. Photo is ~3 mm across.

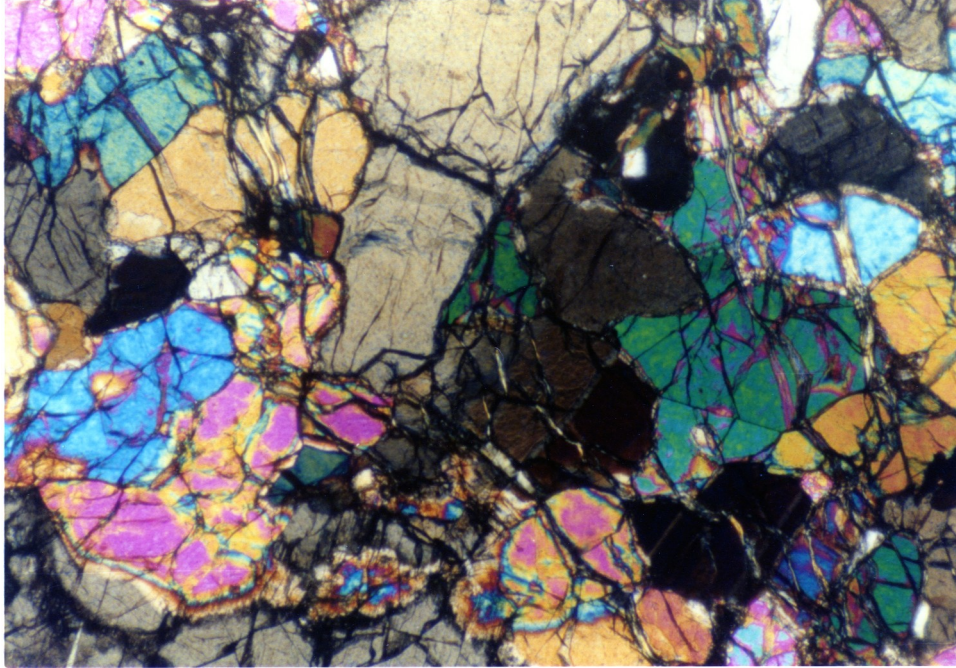


Fig. 5.12. Photomicrograph of remarkably fresh harzburgite (HP-834) with coarse-porphroclastic texture. Lattice fabric is shown in Figure 5.13. Photo is ~3 mm across.

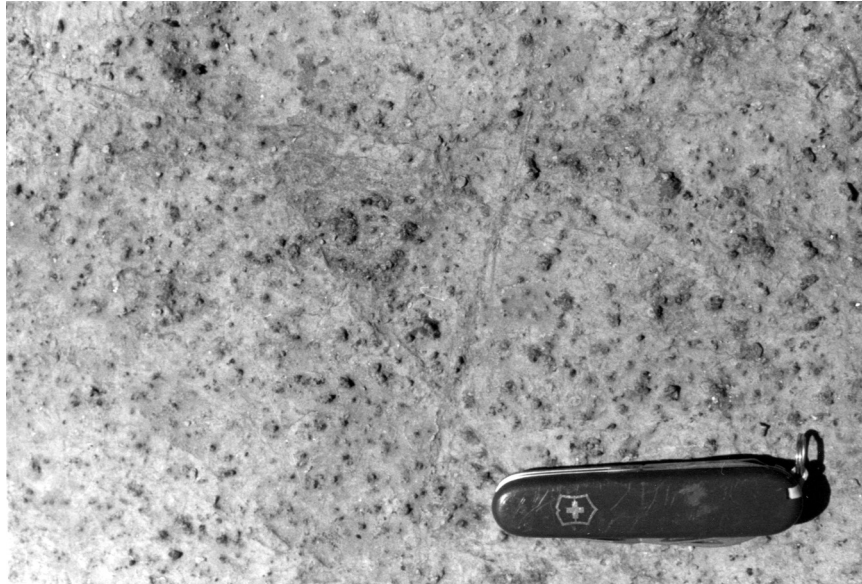


Fig. 6.4. Harzburgite with isotropic appearance from stratigraphically above the Red Mountain shear zone. Although a shape fabric is not evident, a strong lattice fabric may well be present.



**Fig. 6.5.** Harzburgite from stratigraphically beneath the Red Mountain (detachment) shear zone with pronounced mantle flow foliation. Foliation is subparallel to the detachment shear zone.

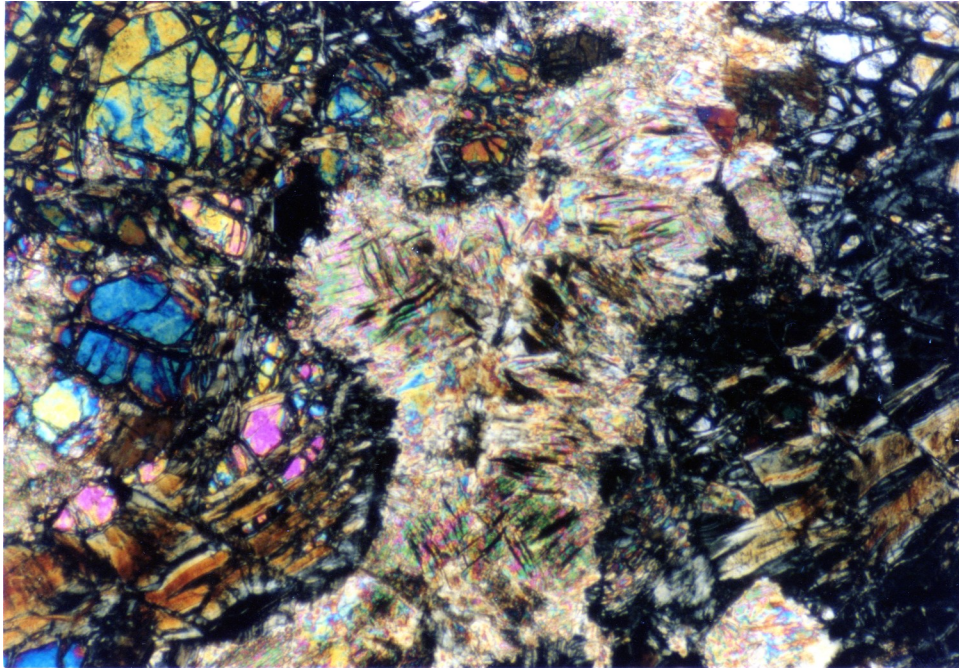


Fig. 6.7. Photomicrograph of talc-bearing harburgite, north of Lookout shear zone and west of Red Mountain shear zone. Photo is about 5 mm across.