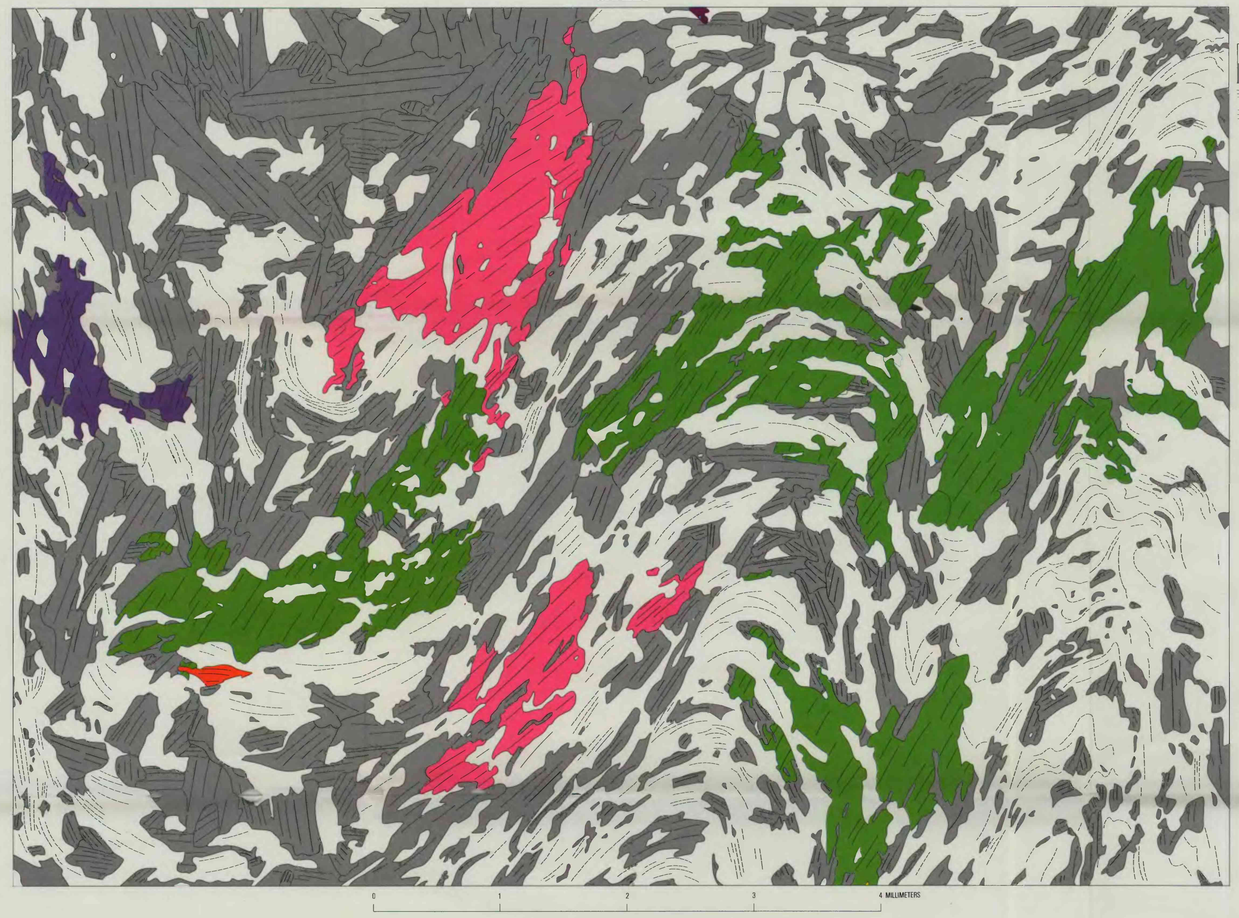
A, B, SIGNIFICANT METAMORPHIC MINERALS AND TEXTURES IN METAMORPHOSED SHALES



EXPLANATION

All colors — MUSCOVITE—Grains shown with identical colors have identical crystallographic orientation

QUARTZ AND PLAGIOCLASE—Individual grains not shown

BIOTITE

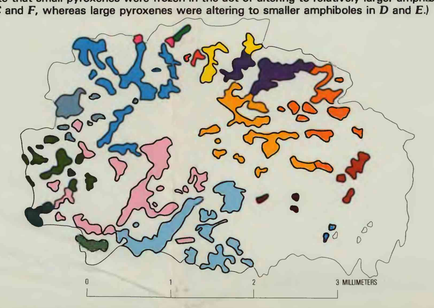
TRACES OF BASAL CLEAVAGE IN MICAS

ALINED SWARMS OF MICROLITES—Include some sillimanite

A, **PALIMPSEST TEXTURE IN SAMPLE 450, COLLECTED NEAR THE HAYDEN-ARCHER POWERLINE SOUTHEAST OF BUFFALO PASS. NOTE THAT AN EARLY FOLD PATTERN, REFLECTED BY MANY BIOTITES AND THE SILLIMANITE SWARMS, HAS BEEN OVERPRINTED BY LARGE MUSCOVITE GRAINS WHICH HAVE DELICATE POIKILITIC STRUCTURES THAT COULD NOT HAVE SURVIVED DYNAMIC MOVEMENT. SAMPLE DEMONSTRATES THAT QUIET THERMAL RECRYSTALLIZATION CONTINUED AFTER DYNAMIC FOLDING AND SHEARING CEASED.**

C-F, COMPLEX TEXTURAL RELATIONS BETWEEN AMPHIBOLE AND PYROXENE IN SMALL ULTRAMAFIC BODIES

(Note that small pyroxenes were frozen in the act of altering to relatively larger amphiboles in *C* and *F*, whereas large pyroxenes were altering to smaller amphiboles in *D* and *E*.)



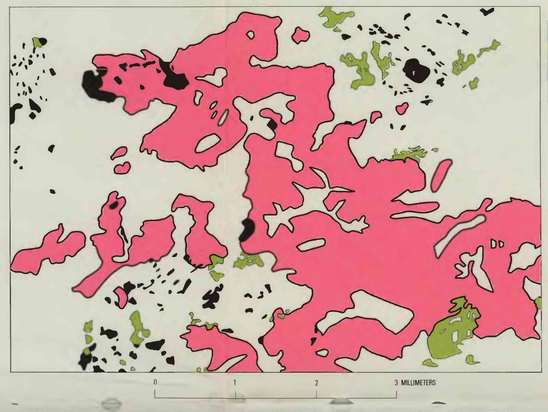
EXPLANATION

OUTLINE OF SINGLE LARGE, POIKILITIC HORNBLENDE XENOBLAST

OUTLINES OF CLINOPYROXENE INCLUSIONS IN HORNBLENDE—Grains shown with identical colors have similar crystallographic orientations

SMALL HORNBLENDE INCLUSIONS—Crystallographic orientations differ from that of main xenoblast

C, **SINGLE HORNBLENDE CRYSTAL IN SAMPLE 1731 FROM A HORNBLENDITE POD NEAR A FOLD CREST IN A SILLIMANITE-GARNET SCHIST IN ROAD CUT WEST OF RABBIT EARS PASS (Fig. 1). LARGE METAMORPHIC AMPHIBOLE APPARENTLY FORMED FROM AN AGGREGATE OF 17 SMALLER IGNEOUS(?) CLINOPYROXENE CRYSTALS (COLORED).**



EXPLANATION

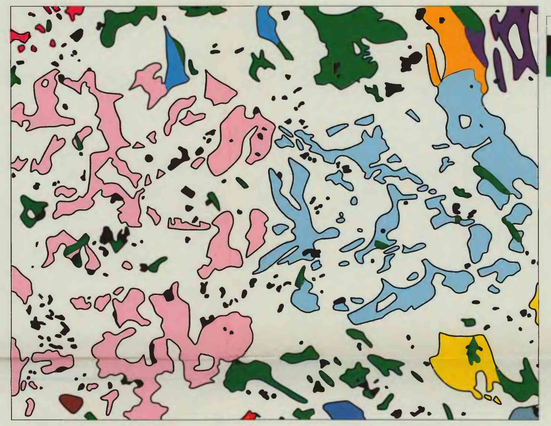
HYPERSTHENE SINGLE CRYSTAL

SPINEL

MAGNETITE

HORNBLENDE—Aggregate of many light-green grains 0.1-0.3 mm in length. Grain outlines not shown.

D, **PART OF A SINGLE HYPERSTHENE CRYSTAL IN SAMPLE 1202 FROM HYPERSTHENE HORNBLENDITE INTRUDING SILLIMANITE SCHIST AT THE 10,590-FOOT (3,228-M) ELEVATION NEAR THE HEAD OF GILPIN CREEK. HYPERSTHENE GREW OR WAS MODIFIED DURING METAMORPHISM. CLUSTERS OF GRAINS OF SPINEL AND MAGNETITE MAY MARK THE SITES OF FORMER OLIVINE GRAINS IN ORIGINAL IGNEOUS ROCK. NEARBY PEGMATITES CONTAIN ANGULAR INCLUSIONS OF ULTRAMAFIC BIOTITIC HORNBLENDITE.**



EXPLANATION

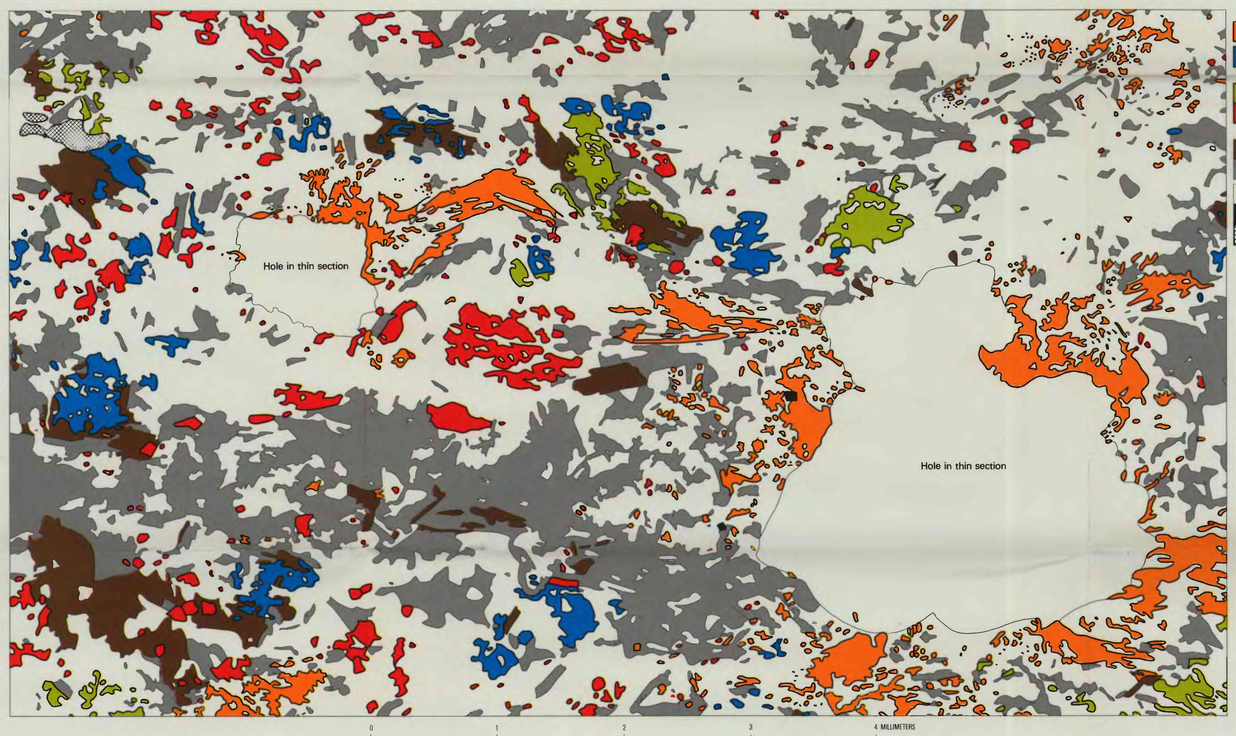
ENSTATITE

MAGNETITE

All other colors — CHLORITE—Coarse crystals or aggregates having random crystallographic orientations

CLINOAMPHIBOLE—Eleven different crystals. Separate parts of each crystal (having the same orientation) are shown with the same color

E, **SMALL PART OF A SINGLE SUBHEDRAL ENSTATITE PHENOCRYST (SAMPLE 1194; TABLES B3 AND B4) FROM A CHLORITIC HORNBLENDITE BODY NORTH OF THE SAWTOOTH RANGE. SIEVELIKE OIKOCRYSTS OF CLINOAMPHIBOLE OR CHLORITE MUST HAVE FORMED UNDER SOLID-STATE METAMORPHIC CONDITIONS. ENSTATITE PHENOCRYST WAS ABOUT 10 CM LONG, 4 CM WIDE, AND 2.5 CM DEEP AND HAD A VOLUME OF 100 CM³ AND A CROSS SECTIONAL AREA OF 10 CM². AREA OF THIS ILLUSTRATION IS LESS THAN ONE-THIRD OF A SQUARE CENTIMETER.**



EXPLANATION

SILLIMANITE—Mainly fibrous bundles, but includes some euhedral prisms

KYANITE—Anhedral, poikilitic grains that have well-developed cleavages; locally associated with single large muscovite crystals

ANDALUSITE—Widely scattered anhedral, poikilitic grains

STAUROLITE—Yellow, pleochroic grains of two types: large anhedral, poikilitic grains (as in center of drawing), and small euhedral grains throughout groundmass

MUSCOVITE—Generally large single crystals

BIOTITE—Generally clusters of small grains; individual grains not shown

QUARTZ AND PLAGIOCLASE—Individual grains not shown

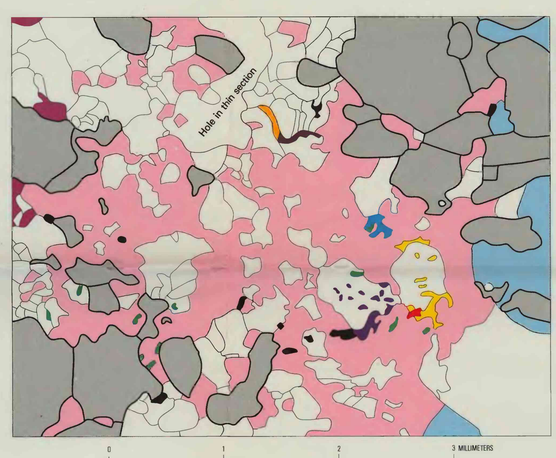
ZIRCON—Two euhedral grains left of right hole in thin section

ALLANITE—Two zoned grains in upper left corner

B, **ALUMINUM SILICATE TRIPLE-POINT ASSEMBLAGE—ONE OF THE LOWEST METAMORPHIC GRADE EQUILIBRIUM MINERAL ASSEMBLAGES IN THE ENTIRE NORTHERN PARK RANGE—FROM SAMPLE 127-67 COLLECTED BY E. J. YOUNG IN WILLOW CREEK CANYON IN 1967. ONLY ONE OTHER SAMPLE, WHICH CAME FROM THE SAME SMALL AREA ALONG WILLOW CREEK, WAS FOUND TO CONTAIN KYANITE. FOR DETERMINATION OF CHEMICAL EQUILIBRIUM NOTE THAT, EVEN THOUGH THE MAJOR MINERALS TEND TO CLUSTER WITH THEIR OWN KIND, THE AREAS OCCUPIED BY EACH TEND TO OVERLAP WITH AREAS OCCUPIED BY OTHERS, AND EACH MAJOR MINERAL SHOWN HERE IS IN DIRECT CONTACT WITH ALL OTHER MAJOR MINERALS.**

Addenum: After this plate was prepared for publication, C.A. White and C.T. Foster, Jr. (Geological Society of America Abstracts with Programs v. 19, p. 342, 1987) reconfirmed the presence of kyanite at this locality (Willow Creek Canyon), the only kyanite known from the northern Park Range.

White and Foster also calculated metamorphic pressure and temperature conditions of about 5 kb and 600°C for samples from this same locality. This pressure value is above the stability limit for andalusite and casts suspicion on the "andalusite" depicted here. This "andalusite" might actually be kyanite observed at an optical orientation that masked its true identity, but this theory cannot be checked at time of this writing (6/1/88) because the thin section on which this drawing was based is on loan to White and Foster. The temperature and pressure conditions determined for this area may be very local, however, so there is no reason to doubt the other andalusite localities shown on plate 1*C*.



EXPLANATION

MAGNETITE

CARBONATE

OLIVINE—Variously oriented

CLINOPYROXENES—Equant to euhedral grains having various orientations; some have mottled patches of a late pargasitic clinoamphibole

All other colors — PARGASITIC CLINOAMPHIBOLE—Nine different crystals; each color represents a single crystallographic orientation

F, **BEAR CREEK AMPHIBOLE WEHRLITE (SAMPLE 752 FROM Xep BODY ON SOUTHEAST PART OF MAP OF SYNDER, 1980B) FROM SAME OUTCROP AS ANALYZED SAMPLE 1018 (TABLES B3 AND B4; FIGS.19*F* AND *G*). CENTRAL SINGLE POIKILITIC GRAIN OF PARGASITIC HORNBLENDE IN APPARENT EQUILIBRIUM WITH BOTH CLINOPYROXENE AND OLIVINE.**

TRACINGS OF THIN SECTIONS SHOWING SIGNIFICANT MINERALS AND TEXTURAL RELATIONS IN METAMORPHIC ROCKS FROM THE NORTHERN PARK RANGE, COLORADO