Field Trip No. 5

CONTACT METAMORPHIC MINERALS AT CRESTMORE QUARRY, RIVERSIDE, CALIFORNIA

by

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INTRODUCTION

The world famous Crestmore mineral locality is located in the northernmost portion of the Peninsular Range physiographic province of southwestern California, about three miles north of Riverside.

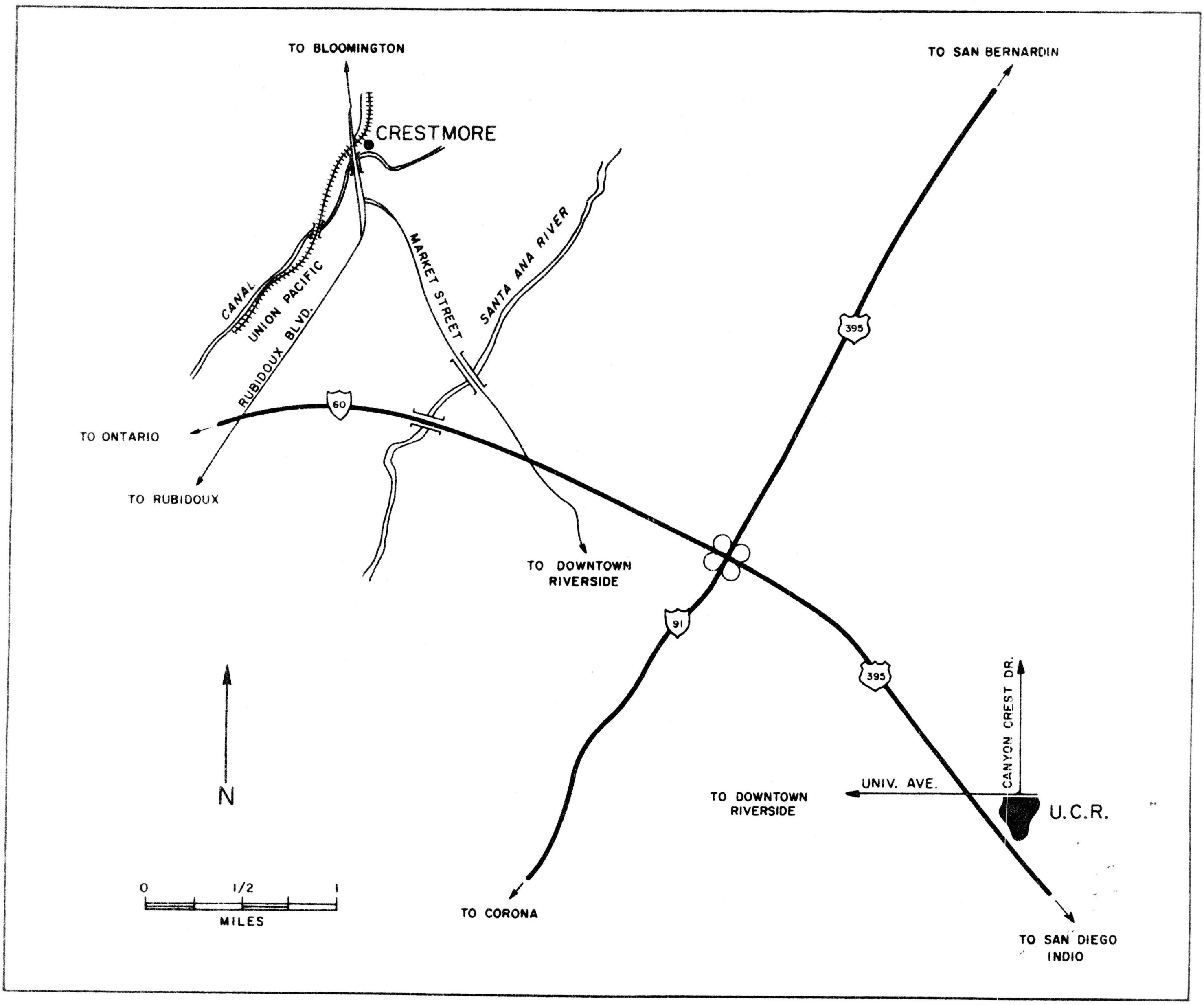

Figure 1. Location of Crestmore.

Here, contact metamorphism and metasomatism of a magnesian limestone has developed an assemblage of *over 140 different mineral species.*

This locality is rivaled only by Franklin, New Jersey, and Langbån, Sweden in the number and variety of mineral species developed at a single locality.

The contact zones between the intrusive rocks and metasediments have been exceptionally well exposed in four quarries (named the Wet Weather, Lone Star, Chino, and Commercial quarries) which were developed around Chino and Sky Blue Hills, located just east of the Jurupa Mountains.

Quarrying began in 1909 and continues to date. At present, the bulk of the production at Crestmore is from underground operations in which block caving techniques were used to mine the marble up until 1953 (this is probably the only cement mine in the world in which this method of mining was used). The deposit is currently mined underground by a room and pillar method.

The deposit is owned and operated by the American Cement Company which mines marble for raw materials for the production of cement. Rock is quarried periodically for rip rap and aggregate.

GENERAL GEOLOGY

Crestmore is located just east of the Jurupa Mountains in the northernmost portion of the Peninsular Range province of southwestern California.

The igneous rocks in the vicinity of Crestmore are the northernmost exposures of the composite southern California batholith of late Mesozoic age. These rocks range in composition from gabbro through granite.

The metasedimentary rocks occur as roof pendants and screens between the individual plutons of the unroofed southern California batholith. These metamorphic rocks are predominately quartzo-feldspathic and pelitic in composition but contain subordinate lenses and layers of carbonate rocks. In the Crestmore area, the metasediments form a regional homoclinar structure.

Pre-Batholithic Metasedimentary Rock

The metasedimentary rocks in the Crestmore area—marble, gneiss, schist, and quartzite—were named the Jurupa series by Daly (1935).

The age of the metasedimentary rocks in the northern Peninsular Range province is clearly pre-batholithic in age. These rocks are variously assigned to a Paleozoic or early Mesozoic age by different workers. The chief problem in dating these rocks lies in the fact that fossil remains were destroyed during metamorphism and recrystallization of the sediments.

Mackevett (1951) estimates the metamorphic sequence to be at least 3500 feet thick in the Crestmore area. The original thickness of the sedimentary sequence into which the batholith was intruded is not determinable. Burnham's (1954) description of the metasedimentary sequence at Crestmore is summarized in Table 1.

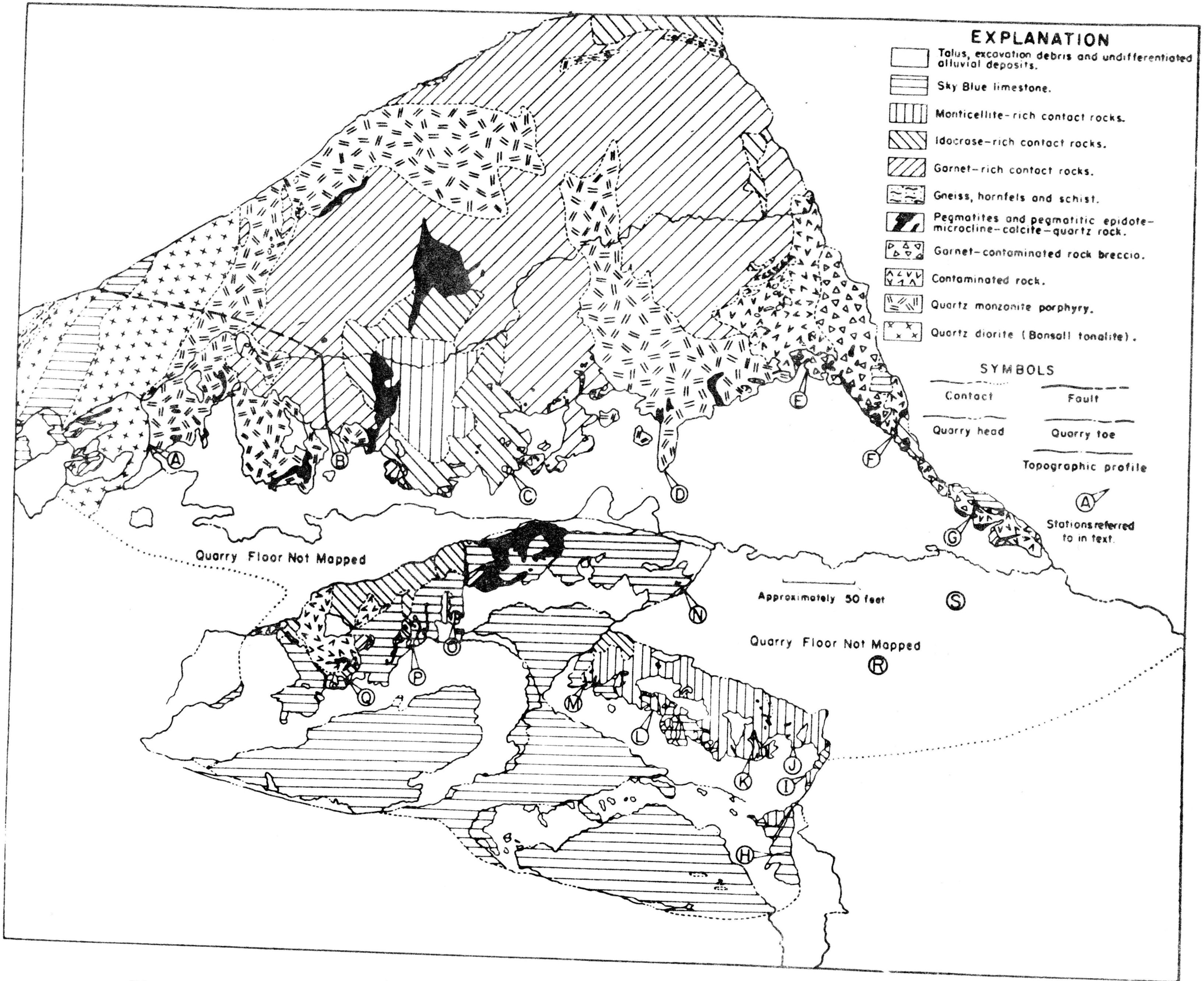

Figure 2. Generalized geologic map of the Commercial quarry, Crestmore (after Burnham, 1954).

TABLE 1

From Burnhams' (1954) data:

UNIT	THICKNESS
Sky Blue Limestone	500 feet (±)
Gneissic Hornfelses and Schists	70-200 feet
Chino Limestone	400 feet
Hornfelses	?

The two marble units of the Jurupa series, the Sky Blue and Chino limestones, are significant from a mineralogical standpoint in that they are the host rocks for most of the interesting minerals.

Burnham (1954) points out that both marble units are petrographically and chemically similar. His analyses of unmetasomatized marbles indicate that these were relatively pure and had original alumina and silica contents of 0.4 and 2.0 percent respectively.

The marble units consist of alternating layers of brucite marble (predazzite) and relatively pure calcite marble. Burnham (1954) interprets this feature as relict bedding and states that the magnesium content of the marble units rarely exceeds 25 percent even in the brucite rich layers.

The metasediments were metamorphosed to a relatively high grade prior to metasomatism. This is indicated by the presence of pseudomorphs of brucite after octahedral periclase crystals within the predazzite.

Burnham (1954) attributes the previous metamorphism to the intrusion of the quartz diorite pluton which constitutes the country rock at Crestmore. It is probable, however, that these rocks suffered regional metamorphism prior to intrustion of the southern California batholith.

The gneiss and schist units in the region consist of assemblages of quartz-biotite-K-feldspar-plagioclase with minor muscovite in various proportions. Minor occurrences of amphibole bearing schists occur in the Jurupa Mountains, west of Crestmore.

MacKevett (1951) reports the occurrence of a sillimanite bearing impure quartzite unit 2000 feet thick in the western Jurupa Mountains. Daly (1935) reports that the strain in the quartz of the metamorphic rocks in the Jurupa Mountains is more intense than that in quartz in the adjacent intrusive rocks. He cites this as evidence of pre-batholithic metamorphism of the rocks because the quartz must be pre-batholithic in age, and the strain in the quartz was not annealed by the heat supplied by intrusion of the batholith.

The indications are that the pre-batholithic sediments may have undergone polycyclic polymetamorphism rather than monocyclic polymetamorphism as many students of the area have implied.

The intrusion of the several plutons in the area has developed contact aureoles with marbles, consisting of calc-silicate rocks which usually attain widths of less than 10 feet. The aureoles are characterized by grossularite, calcite, quartz, epidote, wollastonite, diopside, idocrase, etc., as monomineralic rocks or in various combinations of these species. These assemblages are usually consistent with metamorphism of the pyroxene hornfels facies or upper limits of the hornblende hornfels facies with or without additional metasomatic effects.

Igneous Rock

Quartz Diorite

The country rock in the Crestmore area, and the most abundant intrusive rock in the Jurupa Mountains to the west, is a quartz diorite which is included by Larsen (1948), in the Bonsall tonalite. Burnham's (1954) description of the composition of the quartz diorite and MacKevett's (1951) description of the composition of the Bonsall tonalite in the Jurupa Mountains to the west are given in Table II.

TABLE II
MINERAL COMPOSITIONS OF ROCK TYPES IN CRESTMORE AREA

	1	2	3	4
Plagioclase	56.7% (An 44)	60%	30.7% (An 32)	42.4% (An 40)
K-Feldspar	0.3	20	34.5	30.3
Quartz	21.5		28.0	0.4
Pyroxene	1.4		5.2	24.5
Hornblende	9.1	10	0.6	
Biotite	10.9	10	0.1	
Accessories	0.1		0.7	1.8 (sphene) 0.5 (wollastonite)
	100.0%	100%	99.8%	99.9%

1. Quartz Diorite, Burnham (1954)
2. Bonsall Tonalite in Jurupa Mountains (Mackevett, 1951)
3. Quartz Monzonite Porphyry (Burnham, 1954)
4. Contaminated Rocks Average (Burnham, 1954)

The Bonsall tonalite is highly variable from locality to locality, usually medium to coarse grained, hypidiomorphic-granular, and contains numerous inclusions of metamorphic and mafic igneous rocks. Near the borders of the plutons, these inclusions are elongated parallel to the contacts.

Burnham (1954) describes the contact between the quartz diorite and marble at Crestmore as an aureole which is between one inch and two feet wide. The mineralogy of the aureole consists of grossularite, diopside (diallage), wollastonite, with minor quartz, clinozoisite, spurrite, and sulfides. These assemblages are consistent with most author's pyroxene hornfels facies.

Burnham (1954) states that textural evidence indicates that the quartz diorite magma was highly viscous, had a high percentage of crystals relative to liquid, and had much of the magmatic water locked up in early formed biotite and hornblende (which comprise up to 20 percent of the rock) at the time of intrusion. These conclusions imply that the magma was probably in the lower temperature range of crystallization, and afford an explanation of the relatively minor contact effects that the quartz diorite produced in the metasedimentary rocks especially when compared with the quartz monzonite porphyry (q.v.).

A sill-like mass of quartz diorite was intruded into the siliceous metasediments separating the Chino limestone from the Sky Blue limestone. The siliceous metasediments contain lenses of marble which were the sites of deposition of pyrrhotite, chalcopyrite, loellingite, etc., from fluids supplied by the quartz diorite magma (Burnham, 1959).

Burnham (1954) mentions the occurrence of axinite and sulfide bearing pipes of highly siliceous rocks contained within the Chino limestone units which he interprets as being genetically related to the quartz diorite magma.

Quartz Monzonite Porphyry

The quartz monzonite porphyry is one of the most important rocks at Crestmore because it was responsible for supplying the metasomatizing fluids to the marble units. The composition of the quartz monzonite porphyry as given by Burnham (1954) is summarized in Table II.

Burnham (1954) describes the rock as having a xenomorphic-porphyritic texture with a highly variable grain size and an abundance of anhedral andesine (An 37) phenocrysts set in a groundmass of andesine (An 31), orthoclase and quartz with variable amounts of green pyroxene, sphene and apatite.

In the central portions of the quartz monzonite porphyry intrusions, the rock is very leucocratic and poryphyritic and contains pyroxene and sphene (Burnham, 1954). As the contact between the quartz monzonite porphyry and garnet rich contact rocks is approached, the quartz monzonite porphyry becomes increasingly more melanocratic and less porphyritic, the pyroxene gives way to hornblende and biotite, and the sphene is replaced by ilmenite or titaniferous magnetite with reaction rims of sphene. The quartz monzonite porphyry is unchanged at the contacts with the quartz diorite.

Burnham (1954) interprets these changes as being due to contamination of the quartz monzonite porphyry by assimilation of calcareous metasedimentary rocks. The composition of the plagioclase in the groundmass remains unchanged until very high degrees of contamination are reached.

The quartz monzonite porphyry was intruded as two pipe-like masses 200-300 feet in diameter, one along the contact of the quartz diorite and the Sky Blue limestone, the other up through the metasedimentary sequence and terminating in the Sky Blue limestone unit (Burnham, 1954).

The CaO content of the quartz monzonite porphyry indicates that less than 15 percent of the volume occupied by the intrusion was made by assimilation of the marble (Burnham, 1954, 1960). Most of the room was made by arching the overlying Sky Blue limestone into a plunging anticline (Burnham, 1954, 1960) (see Figure 3).

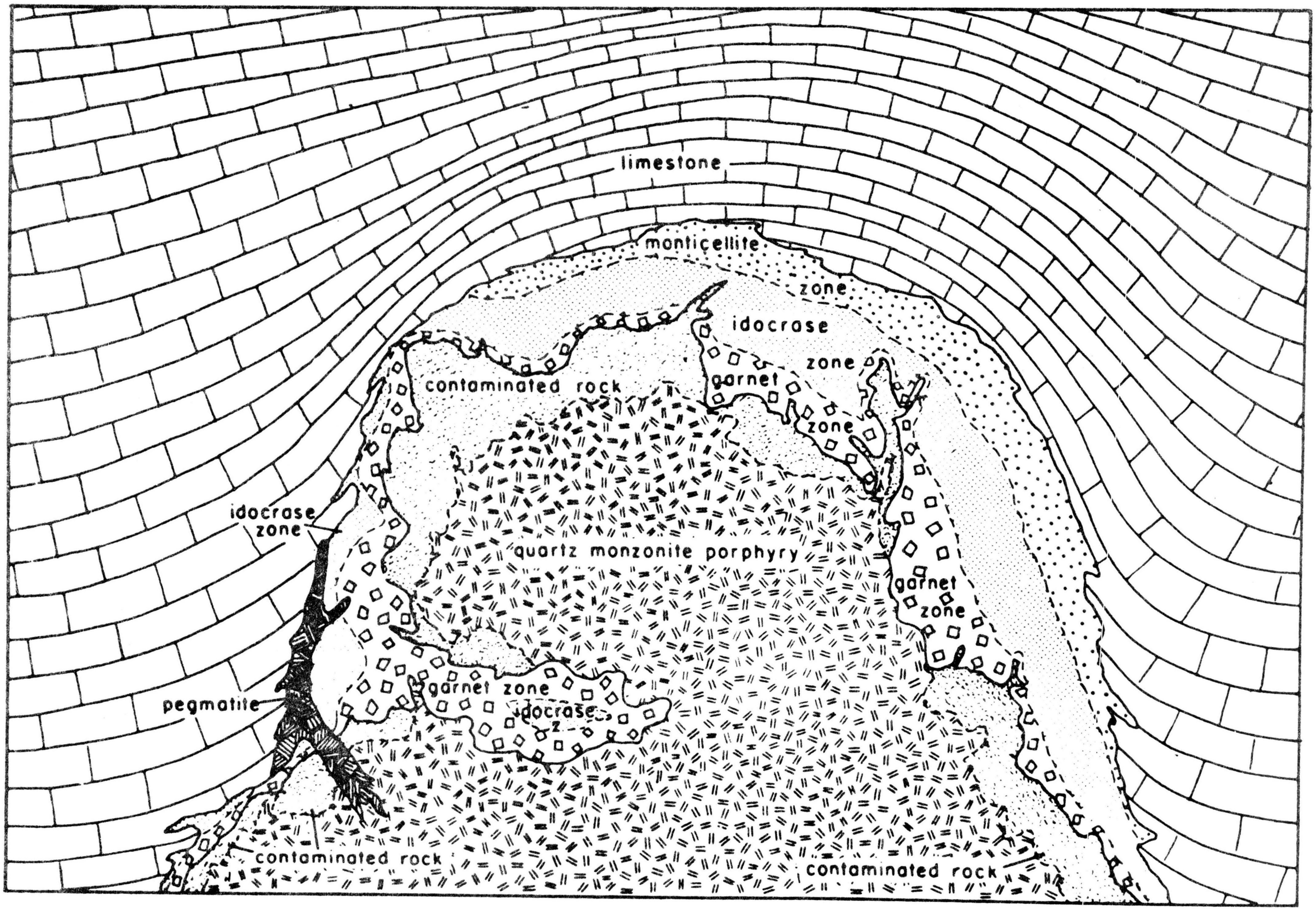

Figure 3. Idealized north-south cross section (not to scale) through the quartz monzonite porphyry intrusion at Crestmore (after Burnham, 1954).

Textural evidence indicates that less than 15% of the quartz monzonite porphyry magma was crystalline at the time of intrusion (Burnham, 1954). No water was fixed in early phases so large quantities of water, free silica and alumina were available for metasomatism of the marble units (Burnham, 1954). There is evidence for large scale metasomatism of the marble units prior to complete crystallization of the quartz monzonite porphyry magma so that the metasomatizing fluids were not from the residuum of crystallization (Burnham, 1954). Burnham (1954) suggests that the release of pressure on the quartz monzonite porphyry magma resulting from intrusion into the reactive and deformable marble units caused the volatiles to separate from the magma and become available for metasomatism of the marble. These fluids transferred heat, silica, alumina, etc., to the marble and served to remove the carbon dioxide produced by the decarbonation reactions taking place in the contact aureole.

The quartz monzonite porphyry developed metasomatic aureoles up to 50 feet wide (Burnham, 1954).

Quartz Monzonite Pegmatites

Pegmatites genetically related to the quartz monzonite porphyry are common at Crestmore (Woodford, 1943). The pegmatites penetrate the unmetasomatized marble for short distances, cut the contact rocks and the marginal portions of the quartz monzonite porphyry intrusions and grade into the quartz monzonite porphyry.

Most are tabular or veinlike and discordant, however some lensoid masses of pegmatite occur in the quartz monzonite porphyry. The distribution of pegmatites is controlled by joints or contacts between rock units (Burnham, 1959).

The quartz monzonite pegmatites are zoned and have the usual pegmatitic texture. Graphic texture is rare (Woodford, 1943). The mineralogy of the quartz monzonite pegmatites is variable and includes quartz, microcline (perthite), oligoclase-andesine, pyroxene, and andradite in central portions of the lensoid pegmatitic masses (Burnham, 1959). The mineral constituents vary between and within dikes, but include such species as andradite, zircon, zoisite (thulite) and allanite (Woodford, 1943). Vugs occur in the intermediate and central portions of some dikes and contain crystals of epidote, prehnite, datolite, laumontite, microcline, wollastonite and quartz some with coatings of hyalite opal (Woodford, 1923, Burnham, 1959). The central openings in some of the vugs are filled with calcite wollastonite or quartz.

Quartz Diorite Pegmatites

Pegmatites apparently genetically related to the quartz diorite are rare at Crestmore but occur abundantly in the Jurupa mountains to the west. These pegmatites have a simple mineralogy and contain schorl and axinite whereas those related to the quartz monzonite porphyry have complex mineralogies and do not contain these two minerals (Woodford, 1943).

Contaminated Rocks

The contaminated rocks were formed as a result of assimilation of the calcareous metasediments by the quartz monzonite porphyry magma.

Burnham (1954) distinguished two types: the first are melanocratic, porphyrytic, pipe-like, and apparently represent terminal portions of apophyses from the main portion of the quartz monzonite magma. The second type is more common, coarser grained, more leucocratic, and was formed at the margins of the intrusion where the magma engulfed large blocks of calcareous metasedimentary rocks. Burnham's (1954) description of the composition of these are listed in Table II.

Some of the textural peculiarities Burnham (1954) describes include an increase in the amount of myrmekitic intergrowths of plagioclase and quartz and also an increase of perthitic feldspar near the contacts of the quartz monzonite porphyry with assimilated calcareous metasediments.

Contact Rocks

The contact aureole surrounding the quartz monzonite porphyry ranges from less than an inch up to 50 feet in width (Burnham, 1954). This aureole exhibits a rough zonation with increased distance from the quartz monzonite porphyry intrusion as follows: (1) the garnet zone; (2) idocrase zone; (3) monticellite zone; (4) unmetasomatized marble and brucite marble (Burnham, 1954). The contacts between the zones are irregular and gradational.

Garnet Zone

The garnet zone is situated closest to the intrusive rocks. It is characterized by the assemblage grossularite-wollastonite-diopside with or without calcite or quartz.

Idocrase Zone

The idocrase zone is characterized by the mineral idocrase. It is roughly separable into two subzones: the inner subzone is characterized by idocrase plus garnet zone minerals; the outer subzone is characterized by the presence of idocrase plus monticellite (Burnham, 1954).

Wilkeite and its alteration product tobermorite as well as merwinite and spurrite occur in this zone. Micaceous and hydrous minerals such as phlogopite and xanthophyllite are also present.

Monticellite Zone

The monticellite zone lies beyond the idocrase zone and extends to the limits of metasomatism. The inner boundary of this zone is arbitrarily drawn at the point where monticellite and associated minerals make up more than 50 percent of the rock (Burnham, 1954). Besides monticellite; gehlenite, spurrite, tilleyite, forsterite, scawtite, spinel, hydrogrossular and calcite occur in the monticellite zone.

Unmetasomatized Rocks

Blue calcite forms a halo around the outside of the contact aureole. Patches of blue calcite occur throughout the contact aureole and may represent aureoles of unmetasomatized marble. The cause of the blue coloration is not due to strain or to inclusions of organic matter, but may be due to lattice defects or to metasomatically introduced trace elements. The blue coloration is most intense in the brucite-free marble, but blue predazzite is common.

Outside of the aureole, the marbles are relatively unaffected except for recrystallization and development of yellow chondradite.

The periclase was probably altered to brucite by residual magmatic waters from the quartz diorite intrusion. This change was probably not due to weathering or alteration by groundwater because predazzite containing fresh periclase occurs at the surface in the area.

The presence of contact rocks of high metamorphic grade in sharp contact with unaffected marble indicates that the assemblage brucite plus marble was stable under the temperature conditions imposed by the quartz monzonite porphyry intrusion, but highly unstable and reactive in the presence of the hot silica and alumina rich metasomatizing solutions supplied by the intrusion.

Origin Of The Contact Rocks And Metamorphic Zones

Any theory of origin must explain: (1) the occurrence of high temperature minerals such as merwinite and spurrite; (2) the sharp contact between the aureole and unmetasomatized marble, and; (3) the occurrence of the monticellite zone (sanidinite facies) more distant from the heat source than the garnet zone (pyroxene hornfels facies) with the idocrase zone lying between them (Burnham, 1954).

These extremely high temperature and low pressure assemblages require temperatures much higher than could have been supplied by the quartz monzonite porphyry magma. This can only be explained in the context of an open system under non-equilibrium conditions (as indicated by the production of such a large number of phases from relatively few components).

In the production of the silicate phases in the marble, silica was added and carbon dioxide was removed. So, the system had to be open to at least these two components. The high temperature mineral assemblages might be formed at lower temperatures in an open system rather than in a closed system.

The sharpness of the contact between the monticellite zone and unmetasomatized marble indicates that the temperature of the rocks was high enough to form sanidinite facies assemblages in the outer portion of the aureole (Burnham, 1954). This probably also accounts for the absence of lower temperature minerals such as tremolite even in the outer portion of the aureole. Another possible explanation for these conditions could be that the marbles attained a very high metamorphic grade prior to metasomatism. In this case the other components in the marble (such as magnesium) were already fixed in phases such as periclase which were stable under the new temperature regime established by the intrusion of the quartz monzonite porphyry.

The temperature to which the marbles were raised made them highly reactive to the metasomatizing solutions.

The zonation in the aureole is the reverse of what would be expected by thermal zoning as proposed by Bowen (1940). (The sanidinite facies is further from the heat source than the pyroxene hornfels facies). So, either the temperature gradient was small, or the effects of the chemical gradients completely overshadowed the thermal effects (first proposed by Burnham, 1954).

If the mineral assemblages were produced by compositional gradients, there should be a gradational variation of chemical components between the different zones. The ratio of calcium plus magnesium to silica is 1:1, 1.5:1 and 2:1 for the garnet zone, idocrase zone and the monticellite zone respectively (Burnham, 1954).

In conclusion, the mineral assemblages should be viewed as the result of decarbonization of the marble under the influence of compositional gradients in a closed system at elevated temperatures rather than a result of temperature gradients alone.

MINERALS OF CRESTMORE QUARRIES

On the following pages is a recent, comprehensive list of the known minerals from Crestmore. Previously described Crestmore occurrences are scattered throughout the literature. Extensive rock removal from the Commercial Quarry during the 1965-1969 period has allowed the discovery of many additional finds. Stations M, L, K, J, R, and S of Figure 2 at the quarry floor (910 level) and on the bench between Wet Weather and Commercial Quarries were diretly affected.

All of the known minerals are listed, and all locations (lettered stations, see Fig. 2) are in the Commercial Quarry unless otherwise stated. Many good finds have been made in the other Crestmore quarries, however these areas are currently inaccessible.

Many interesting finds have been made in the nearby Riverside quarries and Jurupa Hills quarries. Although these areas are not considered part of the Crestmore quarry complex, their similar occurrence has produced the following unique minerals: Jensen Quarry—geikielite, elbaite, tremolite; Old Riverside City Quarry—vonsenite; New Riverside City Quarry —serendibite; and Henshaw Quarry—ferriorthoclase crystals.

Many Crestmore minerals have not yet been identified. Three of these, Minerals F, Y and Z are mentioned at the end of the list because they are frequently encountered near Stations L and K (Fig. 2).

DESCRIPTIVE LIST

R/C/G Rare/Common/General (1965-1970)
* Found by F. Devito (1965-1970)
Numbers following Occurrence—refer to Bibliographic References

Mineral	Crestmore Occurrence
1. ACTINOLITE* R/C $Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$ Mono. H = 5-6; G = 3-3.2	Stations G & A – Green silky masses and blades with epidote and quartz. (16)
2. AFWILLITE* R $Ca_3(SiO_3)_2(OH)_2 \cdot 2H_2O$ Mono. H = 4; G = 2.63	Quarry floor & Station L – colorless to white, thin prismatic xls in veins in merwinite-gehlenite-spurrite rock. Clvg-perfect basal pinacoid. (15)
3. ALLANITE C $(CaCeLa)_2(AlFe)_3Si_3O_1(OH)$ Mono. H = 5.5-6; G = 3.5-4.2	Stations A & S – tabular black xls in pegmatite. Pitchy luster. Occasionally black needles. (13) Station S – tabular xls in plagioclase.*
4. ANDRADITE* C $Ca_3Fe_2(SiO_4)_3$ Iso. H = 6.5-7.5; G = 3.7-4.0	Station B –yellow xls w/idocrase (2). Station P – dark brown xls in pegmatite associated with quartz, microcline and allanite.*
5. ANGLESITE R $PbSO_4$ Ortho. H = 3; G = 6.2-6.4	Minor amounts of earthy gray coatings found on altered galena. (4)
6. APATITE R $Ca_5(PO_4)_3F$ Hex. H = 5; G = 3.15-3.20	Between Stations B & C – pale green prismatic xls associated with calcite and diopside. (16)
7. APOPHYLLITE* C/R $KCa_4Si_8O_{20}(OH,F) \cdot 8H_2O$ Tetrag. H = 4.5-5; G = 2.35	Lone Star Quarry – small pyramidal xls in cavities in limestone w/wollastonite in pegmatite. (16) Station S – silica pseudomorphs on prehnite/pegmatite.*
8. ARAGONITE C/R $CaCO_3$ Ortho. H = 3.5-4; G = 2.94	Stout prismatic xls w/ serpentine, huntite, riversideite. (2)

Mineral	Crestmore Occurrence
9. ARSENOPYRITE* R $FeAsS$ Mono. H = 5.5-6; G = 5.9-6.2	Underground & Wet Weather Quarry – silver white to gray xls replacing lollingite. (13) Station R – small xls in wollastonite.*
10. AUGITE* R/C $(CaMgFeAl)_2(SiAl)_2O_6$ Mono. H = 5-6; G = 3.3	Station B – Dark green-black in contact and mixed rock. (3) Constituent of quartz monzonite porphyry. (1)
11. AXINITE* R/C $Ca_2(FeMn)Al_2BSi_4O_{15}(OH)$ Tric. H = 6.5-7; G = 3.28	Station F – violet blades in pegmatite. (16) Station S – brown-violet xls and masses in quartz, wollastonite w/epidote.* (pegmatite).
12. AZURITE* R $2CuCO_3 \cdot Cu(OH)_2$ Mono. H = 3.5-4; G = 3.8-3.9	Thin coatings, stains on vesuvianite/garnet rock and limestone – quarry floor. (4) Found in mine.
13. BAYLDONITE* C $(PbCu)_7(AsO_4)_4(OH)_2 \cdot H_2O$ Mono. H = 4.5; G = 5.5	Stations F & D -- yellow green coatings and crusts on rock. Not uncommon. (13)
14. BIOTITE* C $K(MgFe)_3AlSi_3O_{10}(OH)_2$ Mono. H = 2.5-3; G = 2.7-3.1	Constituent of quartz diorite & contact rock. (1) Black plates-thin and elongate.* Station A. (16)
15. BORNITE R Cu_5FeS_4 Iso. H = 3; G = 4.9-5.4	Small masses and grains in pegmatite and contact. (4) Found with mixed sulphides in limestone, subsurface.
16. BRUCITE* C $Mg(OH)_2$ Hex. H = 2.5; G = 2.38-2.40	Soft pearly masses and plates in limestone. (4) White, pink, gray in color. Pseudomorphs after periclase octahedrons in limestone. (13)
17. BULTFONTEINITE R $Ca_2SiO_3(OH)F \cdot H_2O$ Tric. H = 4.5; G = 2.73	Near Station K – colorless to pink sugary streaks of small radiating acicular xl groups. Found in veins of massive afwillite & scawtite. (8)

Mineral	Crestmore Occurrence
18. CALCITE* G $CaCO_3$ Hex. Rhom. H = 3; G = 2.71	Coarsely crystalline blue & white in limestone. (13) Gray to black in pegmatite – Station S.* Crystals in pegmatites.*
19. CERUSSITE* R $PbCO_3$ Ortho. H = 3-3.5; G = 6.5-6.6	Station F – alteration of galena. (4)
20. CHABAZITE R $(CaNa)_2Al_2Si_4O_{12}\cdot 6H_2O$ Hex. Rhom. H = 4.5; G = 2.12	White to colorless xls found in mine. (2)
21. CHALCOCITE R Cu_2S Ortho. H = 2.5-3; G = 5.5-5.8	Small amounts found in limestone and metamorphic silicate zones. (4)
22. CHALCOPYRITE* R/C $CuFeS_2$ Tetr. H = 3.5-4; G = 4.1-4.3	Stations C-B – crystals and masses in garnet calcite rocks. (16) Station R with galena & chrysacolla in garnet/diopside rock.* Station E w/chrysacolla.
23. CHONDRODITE* R $Mg_5(SiO_4)_2(OH,F)_2$ Mono. H = 6-6.5; G = 3.1-3.2	Yellow brown grains w/graphite in limestone. Colorless rounded xls w/brucite & periclase in contact rock. (13)
24. CHLORITE (common)* R $(MgAlFe)_{12}(SiAl)_8O_{20}(OH)_{16}$ Mono. H = 2-2.5; G = 2.6-2.9	Wet Weather Quarry – small blue green plates in calcite. (16) Station B – colorless plates 6 cm. across in monticellite-idocrase rock. (16)
25. CHRYSOCOLLA* R/C $CuSiO_3\cdot nH_2O$ H = 2.5-3; G = 2-2.24	Station E – associated (blue coatings) with chalcopyrite in contact rock. (17)
26. CLINOCHLORE R $Mg_3(MgAl)_3(AlSi_3O_{10})(OH)_8$ Mono. H = 2-2.5; G = 2.65-2.78	Lone Star Quarry – pale green flakes 5-10 mm. with pale green diopside. (4, 16)

Mineral	Crestmore Occurrence
27. CLINOHUMITE R $Mg_9(SiO_4)_4(OH,F)_2$ Mono. H = 6-6.5; G = 3.1-3.2	Small yellow-brown xls with spinel in limestone near the quartz diorite contact. (1)
28. CLINOZOISITE* R/C $Ca_2Al_3(SiO_4)_3(OH)$ Mono. H = 6; G = 3.2	Station C – pale brownish striated xls in divergent groups in pegmatite-associated with sphene. (16)
29. CUPRITE R Cu_2O Iso. H = 3.5; G = 5.8-6.1	Between Stations C & B – oxidations coating on chalcopyrite in garnet/calcite contact zone. (16)
30. CUSPIDINE R $Ca_4(Si_2O_7)(F,OH)_2$ Mono. H = 5; G = 2.91	Greenish gray fine granular masses found with idocrase. (13)
31. DANBURITE R $CaB_2Si_2O_8$ Ortho. H = 7-7.5; G = 3.0	Colorless to yellow brown – in pegmatite. (4)
32. DATOLITE* C $Ca_2B_2(SiO_4)_2(OH)_2$ Mono. H = 5-5.5; G = 2.9-3.0	Station S – large masses and crystals of yellow green datolite occur with flesh colored prehnite in pegmatite.* Station F in pegmatite. (3)
33. DIOPSIDE* C $CaMg(SiO_3)_2$ Mono. H = 5-6; G = 3.2-3.3	Pale to dark masses and crystals in limestone. (16) Station R – large xls and masses showing perfect basal parting.* Diallage var. w/grossularite-yl.gn. centers.*
34. DOLOMITE* C $CaMg(CO_3)_2$ Hex. Rhom. H = 3.5; G = 2.8	Common constituent of Chino marble. (2) Occur as veinlets. (16)
35. ELLESTADITE R $Ca_5(S,Si,P)O_{12}(OH,F,Cl)$ Hex. Prism. H = 5; G = 3.07	Wet Weather Quarry – pale rose stringers occur associated with wollastonite, idocrase and diopside. (16) Station M-L – rose to yellow in calcite.

Mineral	Crestmore Occurrence
36. EPIDOTE* C $Ca_2(AlFe)_3Si_3O_{12}(OH)$ Mono. H = 6-7; G = 3.3-3.5	Deep green xls to 6 cm in calcite in pegmatite. (16) Station E-F – green crystalline masses. (16) Station R – found with axinite.*
37. ETTRINGITE* R $Ca_6Al_2(SO_4)_3(OH)_{12}\cdot 26H_2O$ Hex. H = 2.5; G = 1.78	Small hexagonal xls, colorless to white, found with afwillite & calcite in spurrite/gehlenite. (9) Striations parallel to c axis. (9)
38. FLUOBORITE R $Mg_3(BO_3)(F,OH)_3$ Hex. H = 3.5; G = 2.89	Station N – irregular variegated prisms, white, with wightmanite & ludwigite in dolomite/calcite. (11)
39. FORSTERITE R Mg_2SiO_4 Ortho. H = 6-7; G = 3.2-3.3	Pale cream-yellow green grains with monticellite in contact rocks. (1) Station M-L.
40. FOSHAGITE* R/C $Ca_4Si_3O_9(OH)_2$ Ortho. H = 3; G = 2.67	Stations M-L – white silky fibers on slip faces. (4, 16) Occasionally assoc. w/blue spots of unknown CuCa silicate. (10) Forms alteration around tilleyite.
41. GANOMALITE* R/C $Ca_4Pb_6Si_6O_{21}(OH)_2$ Hex. H = 3; G = 5.7	Station L-K – Gray coatings and drusses, (probably gaurmalite) with nasonite and Woodford's Min. F occur on fracture surfaces in idocrase/wollastonite rock.* (personal communication Murdoch, 1969)
42. GALENA* R/C PbS Isom. H = 2.5; G = 7.4-7.6	Large cubes found during early operations. (4) Found with other sulfides in mine. Disseminated as pellets in blue limestone. Stn. L*
43. GEHLENITE*-AKERMANITE* C $CaAl(SiAl)_2O_7$ Tetr. H = 5.5-6; G = 3.0	Colorless to pale yellow masses intimately intergrown w/merwinite/spurrite/diopside. (12) Station L-K – crossed with thaumasite veins.*

Mineral	Crestmore Occurrence
44. GONNARDITE R $CaNa_2Al_4Si_6O_{20} \cdot 6H_2O$ Ortho. H = 4.5-5; G = 2.3	White silky radiating fibers associated with wollastonite. (13)
45. GRAPHITE* G C Hex. Rhom. H = 1-2; G = 2.15	Flakes occur abundantly in the brucite limestone. (16) Common in the Chino limestone. (16)
46. GROSSULARITE* C/G $Ca_3Al_2(SiO_4)_3$ Iso. H = 6.5-7.5; G = 3.53	Station R – well developed xls to 6 cm. in pegmatite calcite.* Abundant compact to sugary grossularite occurs w/diopside and idocrase. (16)
47. GYPSUM R $CaSO_4 \cdot 2H_2O$ Mono. H = 1.5-2; G = 2.31	Lone Star Quarry – selenite found associated with sphalerite. (16)
48. GYROLITE R $Ca_4Si_6O_{15}(OH)_2 \cdot 3H_2O$ Hex. rhom. H = 2.5; G = 2.51	White platy lamellar to compact masses found between fledspars. Associated w/prehnite & datolite. Wet Weather Quarry. (13)
49. HAWLEYITE R CdS Iso. H = 3; G = 5	Orange coatings on sphalerite in idocrase garnet rock considered greenockite at Crestomre until recently. (2)
50. HEMATITE R/C Fe_2O_3 Hex. H = 5.5-6.5; G = 5.2	Common as earthy masses and stains. (4) Lone Star Quarry – alterations of chalcopyrite. (16)
51. HEMIMORPHITE R $Zn_4Si_2O_7(OH)_2 \cdot H_2O$ Ortho. H = 4.5-5; G = 3.4-3.5	Lone Star Quarry – prismatic xls and masses found with smithsonite. Association sphalerite and galena. (13)
52. HILLEBRANDITE* R/C $Ca_2SiO_4 \cdot H_2O$ Ortho. H = 3.4-4.5; G = 2.67	Found in irregular veins as a white fibrous material intimately mixed with foshagite. (4) Stations M to L. (16)

Mineral	Crestmore Occurrence
53. HORNBLENDE R/C $(CaNa)_2(MgFeAl)_5(SiAl_8O_{22})(OH)_2$ Mono. H = 5-6; G = 3.2	Station A to B in quartz diorite. (1) Pargasite, in large well developed xls (17) and uralite also found in quarry.
54. HUNTITE* R/C $Mg_3Ca(CO_3)_4$ Hex.	White incrustations on monticellite rock. (2) White chalky porcelain like masses & veins in the limestone (p.c. Murdoch, 1969).
55. HYDROGROSSULAR (PLAZOLITE) R $Ca_3Al_2Si_2O_{10} \cdot 2H_2O$ Iso. H = 6.5; G = 3.13	Colorless, white to light yellow minute xls with idocrase. (12) Tetrahedral xls to 20 mm occur w/ monticellite in calcite. (p.c. Schwartz) (Above Station M)
56. HYDROMAGNESITE* C/R $Mg_4(OH)_2(CO_3)_3 \cdot 3H_2O$ Mono. H = 3.5; G = 2.16	Occurs as alteration of brucite in massive chalky crusts. Radial groups of colorless prismatic xls to 8 mm on calcite-Station M.*
57. HYDROTROILITE R $FeS \cdot nH_2O$ Amorphous	Lone Star Quarry – black coatings in contact zones – probably hydrotroilite. Species validity questioned (p.c. Woodford, 1971).
58. IDOCRASE* C/G $Ca_{10}(MgFe)_2Al_4Si_9O_{34}(OH)_4$ Tetr. H = 6-6.5; G = 3.4-3.5	Green to brown flat pyramidal xls to 15 cm found in the limestone-contact zone. (16) Station R & L – xls to 5 cm w/ monticellite.*
59. ILMENTITE R $FeTiO_3$ Hex. rhom. H = 5-6; G = 4.5-5	Station J – ilmenite found w/ scapolite in contaminated rocks. (1)
60. JENNITE R $Na_2Ca_8(SiO_3)_3Si_2O_7(OH)_6 \cdot 8H_2O$	White material, found with tobermorite, filling fractures in contact rock. (13)
61. KAOLINITE R $Al_2SiO_5(OH)_4$ Mono. H = 2-2.5; G = 2.6	White alteration product – Wet Weather Quarry. (16)

Mineral	Crestmore Occurrence
62. LAUMONTITE* R/C $CaAl_2Si_4O_{12} \cdot 4H_2O$ Mono. H = 3.5; G = 2.25-2.35	Station D – white, friable, radiating masses and divergent columnar xls in pegmatite. (16) Station S – xls to 10 mm w/ prehnite in pegmatite.*
63. LIMONITE* G $Fe_2O_3 \cdot nH_2O$ H = 5-5.5; G = 3.6-4	Common as small earthy masses and stain. (4) Found as pseudomorphs after pyrite – Station R.* Found in leached brucite cavities – Station M. (4)
64. LOLLINGITE R $FeAs_2$ Ortho. H = 5-5.5; G = 7-7.4	Found in mine as silver white masses in mixed sulfide lenses in the limestone. (13)
65. LUDWIGITE* R $(MgFe^2)_2(Fe^3)BO_5$ Ortho. H = 5; G = 4.0	Wet Weather & Lone Star Quarries – black prisms and black fibrous masses in limestone. (16) Station N w/ other borate in limestone. (11)
66. MAGNESIOFERRITE R $(MgFe)_3O_4$ Iso. H = 5.5-6; G = 4.6	Small black shiny cubes & octahedra in limestone (p.c. Murdoch, Schwartz, 1953) Station M-L.
67. MAGNESITE R/C $MgCO_3$ Hex. H = 3.5-4.5; G = 3.0-3.1	White coatings; dense white veinlets found as alteration product of Mg limestone. (2, 16)
68. MAGNETITE R Fe_3O_4 Iso. H = 5.5-6.5; G = 5.1	Station D, found in quartz diorite and quartz monzonite. Also found in Lone Star quarry. (17)
69. MALACHITE R $Cu_2CO_3(OH)_2$ Mono. H = 3.5-4; G = 3.9-4	Stations D to E – stains from chalcopyrite alteration in garnet rock. (16)
70. MANGANITE R $MnO(OH)$ Mono. H = 4; G = 4.3	Station B to C – black stains in contact rock and quartz monzonite. (16)

Mineral	Crestmore Occurrence
71. MARGARITE R $CaAl_4Si_2O_{10}(OH)_2$ Mono. H = 3.5 - 4.5; G = 3.0	Grayish pink aggregated laminae found with white mineral Z in contact rock. (13)
72. MELANTERITE R $FeSO_4 \cdot 7H_2O$ Mono. H = 2; G = 1.9	Found in mine as alteration product of pyrrhotite. (p.c. Woodford). Unstable.
73. MERWINITE* C $Ca_3Mg(SiO_4)_2$ Mono. H = 6; G = 3.15	Compact-granular masses, colorless to pale green masses (13) w/ gehlenite & spurrite & thaumasite – Station K.*
74. MICROCLINE* C $KAlSi_3O_8$ Tric. H = 6-6.5; G = 2.55	Stations F to C – found in pegmatite. (16) Station S found as white masses and crystals, w/ plagioclase, in pegmatite.*
75. MIMETITE R $(PbCl)Pb_4(AsO_4)_3$ Hex. H = 3.5; G = 7-7.25	Minute yellow needles on fracture surfaces in pegmatite. (13)
76. MINIUM* R/C Pb_3O_4 Iso. H = 2.3; G = 4.6	Station L-K – minute red semi-transparent xls found in leached out galena cavities – associated with tilleyite in blue limestone.* (personal communication Devito-Murdoch).
77. MOLYBDENITE R MoS_2 Hex. H = 1-1.5; G = 4.7-4.8	Found in mine in garnet rock. (16)
78. MONTICELLITE* C $CaMg(SiO_4)$ Ortho. H = 5-5.5; G = 3.2	Colorless & gray to dark brown masses, grains and xls in limestone w/ xanthophyllite, garnet, idocrase. (16) Station K-L – 2 cm crystals in limestone.*
79. MONTMORILLONITE R $(MgAl)_2(SiAl_4O_{10})(OH)_2 \cdot nH_2O$ Mono. Soft G = 2	White montmorillonite occurs with prehnite in the mine. (16)

Mineral	Crestmore Occurrence
80. MORDENITE R $Ca(NaK)_2Al_2Si_{10}O_{24} \cdot 7H_2O$ Ortho. H = 5; G = 2.15	White radiating clusters of needles or blades on calcite in diopside/wollastonite rockfractures. Lath-like xls in contact rock. (12)
81. MOTTRAMITE* C $(CuZn)Pb(VO_4)(OH)$ Ortho. H = 3-3.5; G = 5.9	Yellow green coatings commonly found on joint surface – Lone Star and Commercial Quarries. (13)
82. MUSCOVITE* R/C $KAl_3Si_3O_{10}(OH)_2$ Mono. H = 2-2.5; G = 2.8-3	Muscovite and sericite found in schists, quartzite. (4)
83. NASONITE* R/C $Ca_4Pb_6Si_6O_{21}Cl_2$ Hex. H = 4; G = 5.4	Small hexagonal xls and xl rosettes, pale blue to yellow green found on fracture surfaces in garnet idocrase rock. (13) Station L.*
84. NEKOITE R $Ca_3Si_6O_{15} \cdot 8H_2O$ Tric. H = 4.5-5; G = 2.2 - 2.3	White fibrous alteration product of wilkeite. Fibrous botryoidal coatings on apophyllite in the pegmatite. (2, 13)
85. NONTRONITE* C $Fe^{3}{}_4Si_4O_{10}(OH)_8 \cdot 5H_2O$ H = 2.5-4.5; G = 1.72-2.49	Greenish yellow opal like masses. Alteration product. Common, Station B. (17)
86. OPAL* C $SiO_2 \cdot nH_2O$ Amorphous H = 5.5-6.5; G = 2.1	Station R – brown to black banded "wood opal" altering from monticellite.* (16) Station P – colorless botryoidal hyalite.* Station S coating prehnite & apophyllite.*
87. ORPIMENT R As_2S_3 Mono. H = 1.5-2; G = 3.4-3.5	Stations B to C – some orpiment was found with realgar in brown monticellite. (p.c. Woodford, 1971).
88. ORTHOCLASE* C/R $KAlSi_3O_8$ Mono. H = 6; G = 2.5-2.6	Found as a constituent of the quartz monzonite. (1)

Mineral	Crestmore Occurrence
89. PARAWOLLASTONITE* C $CaSiO_3$ Mono. H = 4.5-5; G = 2.8-2.9	Found with triclinic wollastonite. Possibly 10% of the Crestmore wollastonite is parawollastonite. (p.c. Murdoch, 1969).
90. PERICLASE R MgO Iso. H = 5.5; G = 3.5-3.6	Found in Wet Weather Quarry and in the mine. White to colorless, altering to brucite, (14) occasionally replaced by pseudomorphous brucite.
91. PEROVSKITE R $CaTiO_3$ Iso. H = 5.5; G = 4.0	Small amber octrahedra in contact zone. (12) Black cubes associated w/ brown spinel in calcite-quarry floor (910 ft. level).
92. PHILLIPSITE R $KCaAl_3Si_5O_{16}\cdot 6H_2O$ Mono. H = 4-4.5; G = 2.21	Station B – silky white radial aggregates found with scapolite in garnet rock. (16)
93. PHLOGOPITE* R/C $KMg_3AlSi_3O_{10}(OH)_2$ Mono. H = 2.5-3; G = 2.78-2.85	Station G, Chino Hill quarry, Lone Star quarry and mine. (16) Yellow brown to brownish red flakes and pseudo-hexagonal xls in limestone. (12)
94. PLAGIOCLASE* C $NaAlSi_3O_8$-$CaAl_2Si_2O_8$ Tric. H = 6-6.5; G = 2.6-2.7	Most members found in quarry as rock constituents, (2) large white crystals (oligoclase) found with microcline & prehnite at Station S.*
95. PLOMBIERITE 14A C/R $Ca_5H_2Si_6O_{18}\cdot 6H_2O$ Tobermorite group	Found intergrown w/ tobermorite & wilkeite. (13) White crystalline secondary mineral found in altered monticellite rock. (2) Above Station M (p.c. Schwartz, 1970).
96. PREHNITE* C/R $Ca_2Al_2Si_3O_{10}(OH)_2$ Ortho. H = 6-6.5; G = 2.8-3	Stations E-F – green & brown masses in pegmatite. (16) Station S, orange-brown xls w/ apophyllite & datolite. Occasionally perfect single prehnite xls.*

Mineral	Crestmore Occurrence
97. PYRITE* G FeS_2 Iso. H = 6-6.5; G = 5	Grains, cubes, pyritohedra found in the quartz diorite and quartz monzonite. Frequently replaced or coated by limonite. (4)
98. PYROMORPHITE R $(PbCl)Pb_4(PO_4)_3$ Hex. H = 3.5-4; G = 6.5-7.1	Minute yellow xls found in the Wet Weather Quarry. (13)
99. PYRRHOTITE* R/C $Fe_{1-x}S$ Hex. H = 3.5-4.5; G = 4.6	Large masses are found in the mine. (p.c. Woodford, 1971) Reported in the Wet Weather Quarry and Chino Quarry – small crystals. (16)
100. QUARTZ* G SiO_2 Hex. H = 7; G = 2.65	Constituent of igneous rocks. (1) Large dark masses found in pegmatite – Station S.* Druses common.
101. REALGAR R AsS Mono. H = 1.5-2; G = 3.56	Stations B-C, found in brown monticellite. (16)
102. RIVERSIDEITE 9A* R $Ca_5H_2Si_6O_{18} \cdot 2H_2O$ Tobermorite group	White silky fibrous veinlets with residual wilkeite. Found in massive idocrase. (4, 13) Station O (p.c. Schwartz, 1970).
103. RUTILE R TiO_2 Tetr. H = 6-6.5; G = 4.2	Wet Weather quarry, small xls found in the contact rock. (16)
104. SCAPOLITE R $(Na,Ca,K)_4[Al_3(Al,Si)_3Si_6O_{24}](Cl,CO_3,SO_4,OH)$ Tetr. H = 5-6; G = 2.63-2.72	Station B, good transparent to white cloudy xls 1x4 cm, probably meionite, found w/ blue calcite in garnet rock. (16)
105. SCAWTITE* R $Ca_7(SiO_3)_6CO_3 \cdot 2H_2O$ Mono. H = 4.5-5; G = 2.77	Near Station L*, small tabular xls in subparallel aggregates resembling bundles of shingles lining veins in diopside/wollastonite spurrite rock. (7)

Mineral	Crestmore Occurrence
106. SCOLECITE R $CaAl_2Si_3O_{10} \cdot 3H_2O$ Mono. H = 5-5.5; G = 2.2-2.4	Reported from Crestmore (13).
107. SEPIOLITE R $Mg_4(Si_6O_{15})(OH)_2 \cdot 6H_2O$ Ortho. H = 2-2.5; G = 2	Found in fine interlocking fibers in small veinlets in calcite. (3)
108. SERENDIBITE R $(CaMg)_5Al_5BSi_3O_{20}$ Tric. H = 6-7; G = 3.4	Irregular bluish grains found in calcite. (13)
109. SERPENTINE* C $Mg_3Si_2O_5(OH)_4$ Mono. H = 2.5-4.0; G = 2.2-2.6	Found in limestone near contacts as common serpentine, mixtures in dewylite, and chrysotile. (3, 5)
110. SIDERITE R $FeCO_3$ Hex. H = 3.5-4; G = 3.8	Found in mine as honey colored rhombs in cavities. (13)
111. SMITHSONITE R $ZnCO_3$ Hex. H = 5.5; G = 4.4	Lone Star Quarry – globular to crystalline grains w/ galena, sphalerite and hemimorphite. (13)
112. SPHALERITE C/R ZnS Iso. H = 3.5-4; G = 3.9-4.1	Black sphalerite found in mine w/ mixtures of sulfides. Found in Wet Weather and Chino quarry.
113. SPHENE* C/R $CaTiSiO_5$ Mono. H = 5-5.5; G = 3.5	Yellow xls found in pegmatite – Station B. (16) Common in the igneous rocks as brown xls.
114. SPINEL* R/C $MgAl_2O_4$ Iso. H = 8; G = 3.5-4.1	Pale to dark blue green in limestone. Station B – var. ceylonite in small black octahedra in limestone.

Mineral	Crestmore Occurrence
115. SPURRITE* C $Ca_5CO_3(SiO_4)_2$ Mono. H = 5; G = 3.01	Stations L to R* – pale grey to blue gray sugary to compact masses, sometimes pure, usually admixed with merwinite and gehlenite. (13)
116. STERNBERGITE R $AgFe_2S_3$ Ortho. H = 1.5; G = 4.2	Found with mixed sulphides in lenses in the mine. (13)
117. STIBNITE R Sb_2S_3 Ortho. H = 2; G = 4.5-4.6	Wet Weather quarry – found in contact rocks. (16)
118. STILBITE* R/C $CaAl_2Si_7O_{18} \cdot 7H_2O$ Mono. H = 3.5-4; G = 2.1-2.2	Station B – platy xls w/ pearly luster in pegmatite. (16) Station S – small transparent xls commonly occurring on prehnite in pegmatite.*
119. STRONTIANITE R $SrCO_3$ Ortho. H = 3.5-4; G = 3.7	Lone Star Quarry – minute balls of white tufted fibers found on joint surfaces. (16)
120. SZAIBELYITE C/R $MgBO_2(OH)$ Ortho. H = 2-2.5; G = 2.6	Station N – found as white alteration product of borate minerals in dolomite-calcite rock. (11)
121. TALC $Mg_3Si_4O_{10}(OH)_2$ Mono. H = 1-1.5; G = 2.7-2.8	Found in Wet Weather quarry in contact rocks. Occurrence questioned. (16)
122. TETRAHEDRITE R $(CuFe)_{12}Sb_4S_{13}$ Iso. H = 3-4; G = 4.4-5.1	Found in quarry with sulphides in pegmatite. (4)
123. THAUMASITE* C $Ca_3H_2CO_3SO_4SiO_4 \cdot 13H_2O$ Hex. H = 3.5; G = 1.88	Station K – veins of white silky fine fibrous thaumasite occur in spurrite-gehlenite rock.* Small brilliant colorless hex. xls not uncommon. (13)

Mineral	Crestmore Occurrence
124. THOMSONITE R $NaCa_2Al_5Si_5O_{20} \cdot 6H_2O$ Ortho. H = 5-5.5; G = 2.3-2.4	Clusters of prismatic and bladed xls usually white, are found in cavities in quartz and prehnite. (13)
125. THORITE* C/R $ThSiO_4$ Tetr. H = 4.5-5; G = 4.4-5.4	Small irregular resin-like patches (orangeite var.) in pegmatite. (13) Station S found as xls to 20 mm in datolite w/ prehnite & zircon.*
126. TILLEYITE* C/R $Ca_5(CO_3)_2Si_2O_7$ Mono. H = 5?; G = 2.8	White masses and crystals in limestone near contacts. One perfect cleavage. (12) Station L-R, crystals altering to foshagite.*
127. TOBERMORITE 11A* C $Ca_5H_2Si_6O_{18} \cdot 4H_2O$ Ortho. H = 2.5; G = 2.4	White masses and grains common in blue calcite. (13) Station K – pseudomorphs of tobermorite after hexagonal wilkeite xls* – some residual wilkeite sometimes present.
128. TOURMALINE (Schorl)* C/R $Na(Fe,Mn)_3Al_6B_3Si_6O_{27}(OH)_4$ Hex. H = 7-7.5; G = 2.98-3.2	Stations D-F, columnar schorl found in quartz diorite and pegmatite. (16)
129. UVAROVITE R $Ca_3Cr_2Si_3O_{12}$ Iso. H = 7.5; G = 3.45	Minute grains have been found in the limestone. (13)
130. VERMICULITE R $K(Mg,Fe)AlSi_3O_{10}(OH)_2 \cdot nH_2O$ H = 1.5; G = 2.3	Near Station A – brown to black plates to 15 mm probably formed from biotite hydration. Found in pegmatite. (16)
131. WIGHTMANITE C/R $Mg_9B_2O_{12} \cdot 8H_2O$ Tric. H = 5.5; G = 2.59	Station N – colorless pseudohexagonal single prisms or radiating clusters in dolomite calcite rock. (11) Associated w/ fluorborite and ludwigite. (11)
132. WILKEITE* R/C $Ca_5(PO_4SiO_4SO_4)(CO_3)(OHF)$ Hex. H = 5; G = 3.23	Pale rose to yellow masses in calcite w/ diopside idocrase and garnet. (16) Crystals replaced by its alteration product, tobermorite, common in limestone.

Mineral	Crestmore Occurrence
133. WOLLASTONITE* C $CaSiO_3$ Tric. H = 4.5-5; G = 2.8-2.9	White fibrous columnar and granular. (13) Station R – well developed xls (4) to 10 cm found in calcite w/ garnet and idocrase.*
134. XANTHOPHYLLITE* R/C $CaMg_3(AlFe^3)_2Si_2O_{10}(OH)_2$ Mono. H = 4-5; G = 3.08	Light to dark green inflexible platy xls found in blue calcite w/ idocrase & monticellite (16). Found at Stations B-C, L, & Q-P (p.c. Schwartz, 1967.)
135. XONOTLITE R $Ca_3Si_3O_8(OH)_2$ Mono. H = 6.5; G = 2.7	Radiating white fibers to 2 cm, associated with blue calcite & grossularite. (4, 13)
136. ZINNWALDITE R $K_2(Li,Fe,Al)_6(AlSi_3O_{10})_2(F,OH)_4$ Mono. H = 2.5-3; G = 2.8-3.2	Greenish gray flakes found with calcite and idocrase. (13)
137. ZIRCON* C/R $ZrSiO_4$ Tetr. H = 7.5; G = 4.7	Station S, grayish brown xls (elongated dipyramidal) to 20 mm found in datolite and oligoclase in pegmatite.*
138. ZOISITE* R/C $Ca_2Al_3Si_3O_{12}(OH)$ Ortho. H = 6-6.5; G = 3.25-3.37	Station F (16), and S*. Bright pink thulite xls, radial and bladed, found in white plagioclase in pegmatite.
MINERAL F – (Woodford)*	Station L-K. Unknown CuCaAl silico-carbonate, azure to violet coatings on fracture surfaces in garnet/idocrase rock.
MINERAL Y (Murdoch)*	Station L-K. Unknown CuCa silicate hydrate-sky to powder blue, pearly blades disseminated in drop-like pellets in calcite.
MINERAL Z (Murdoch)*	Station L-K. 14A. Unknown Ca silicate hydrate-w/ 2% B_2O_3. White botyryoidal groups of clustered blades. Occurrence as Mineral Y.

TABLE III
LIST OF SYNONYMS, DISCONTINUED NOMENCLATURE, VARIETIES AND DISCREDITED SPECIES

Valid Species	*Synonym*	*Valid Species*	*Synonym*
Laumontite	Caporcianite	Nekoite	Okenite
Gyrolite	Centrallasite	Thorite	Orangeite
Nontronite	Chloropal	Ludwigite	Pageite
Tobermorite	Crestmorite	Hornblende	Pargasite
Cuspidine	Custerite	Hydrogrossular	Plazolite
Serpentine	Deweylite	Mordenite	Ptilolite
Diopside	Diallage	Zoisite	Thulite
Hawleyite (at Crestmore)	Greenockite	Allanite	Treanorite
Xonotlite	Jurupaite	Hornblende	Uralite
Laumonite	Leonhardite	Idocrase	Vesuvianite
Gehlenite-akermanite	Melilite	Ettringite	Woodfordite
		Greenockite	Xanthocroite

TABLE IV
CRESTMORE MINERALS
REPORTED BUT NOT CONFIRMED IN THE LITERATURE

Aurichalcite	Hydrozincite
Cassiterite	Natrolite
Cordierite	Tremolite
Geikielite	Wulfenite

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