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1. Geologist, Bureau of Mineral Resources, Canberra, A.C.T.

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The geology of the Arunta Block has been outlined by Shaw and Stewart (this volume). As the overall geological history of the Arunta Block is still unknown, a metallogenic framework cannot be proposed. Hence, the mineral deposits in the area are described on the basis of their geographic distribution.

NORTHERN ARUNTA AREA

For the purposes of this paper, the northern Arunta area refers to the part of the Arunta Block north of latitude 22°45'S, except for the Jervois-Bonya district. The geology of this area is complex; regional unconformities are present, more than one metamorphic event is thought to have affected the area, and there are extensive granite masses, whose time relationships are not yet clear. In the north-eastern part of the area, the Hatches Creek Group overlies rocks assigned to the Arunta Complex (Smith, 1965), and is intruded by numerous granite bodies. Two of these have been dated (by the Rb-Sr method) at 1695 m.y. (Riley, 1961, and personal communication in Compston and Arriens, 1968) and 1550 m.y. (Hurley et al., 1961). Two of the granites appear to have introduced the tungsten minerals at Wauchope and Hatches Creek, and have given K-Ar dates of 1540 and 1480 m.y., respectively (Hurley et al., 1961). In the northern Arunta area (Fig. 1) the Jinka Granite, at a locality 25 km northeast of Mt Sainthill, has been dated by the Rb-Sr method at 1690 m.y. (Riley, 1961, and personal communciation in Compston and Arriens, 1968), and by the K-Ar method at 1420 m.y. (Hurley et al., 1961).

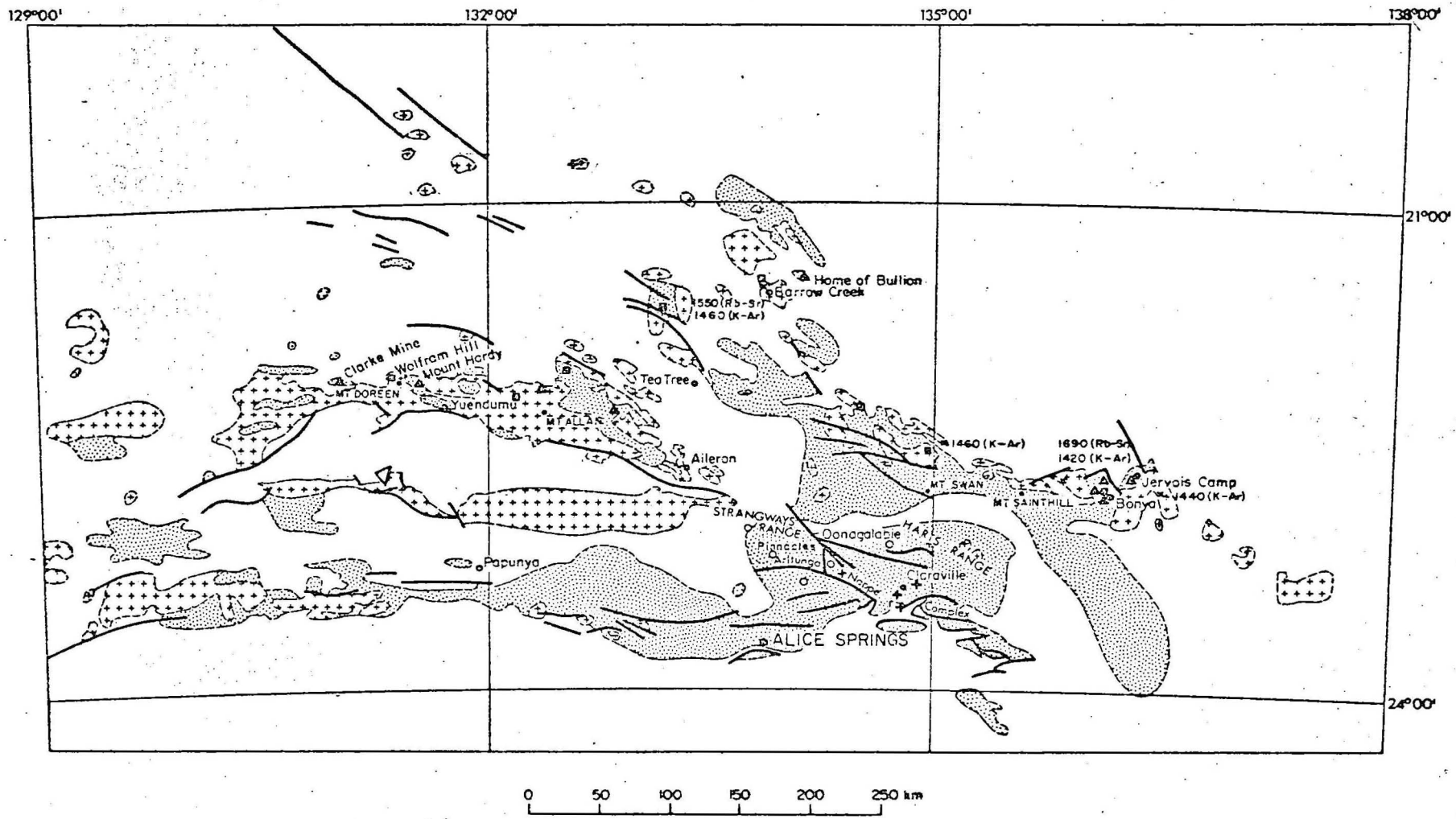

Fig. 1 Distribution of mineral deposits in Arunta Block, N.T.

Modified from 1:2500000 geological map of Northern Territory (B.M.R. in prep.)

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Two other granites, at localities 37 km north-northeast of Mt Swan and 20 km southeast of Jervois Camp, have given K-Ar dates of 1460 m.y. and 1440 m.y. respectively. Thus, the granites in the northern Arunta area are probably of the same age as those that intrude the Hatches Creek Group, and the inference made by Ryan (1962) that much of the mineralization in the northern Arunta area belongs to the same event as the Hatches Creek and Wauchope mineralization still seems to be valid, particularly in the light of the correlations suggested by Shaw and Stewart (this volume, Table I).

The mineral deposits of the northern Arunta area include numerous small occurrences of cassiterite, tantalite-columbite, and wolframite, in or near granitic rocks; several copper, lead, and zinc lodes; and three very small gold lodes.

The tungsten-copper lodes at Wolfram Hill, near Mt Doreen, occur in tension joints in a folded pelite-psammite sequence. The ore has been introduced by pegmatites, and occurs in quartz and quartz-muscovite veins. Production figures are uncertain, but at least 70 tons (72 tonnes) of wolframite have been produced (Clarke, 1969; Anon, 1941). The Mount Allan lode contains both cassiterite and columbite in a kaolinic matrix in a pipelike body close to an intrusive granite. Fruzzetti (1970a) believes that the kaolin formed by deep weathering, but the possibility also exists that it formed by deuteric alteration of a pegmatitic segregation.

The copper, lead, and zinc lodes occupy cross-cutting shears and faults in low-grade pelitic schist. In only one case are the lodes close to granite, namely, at

the Clarke mine west of Mount Doreen (Fruzzetti, 1970b); however, Grainger (1968) considers that the pegmatites in the Mount Hardy copper district, 50 km east of the Clarke Mine, are genetically related to the lodes. The largest of the numerous copper prospects in the Mount Hardy district has been drilled, but not cored. The upper 15 m of cuttings consist of quartz and malachite (3-4% Cu), followed at depth by chalcopyrite, quartz, and minor galena, with a grade of about 1% Cu. The carbonate ore is being mined from small open cuts to provide material for a leaching plant at Yuendumu (Grainger, 1968).

The largest mine in the northern Arunta area is the Home of Bullion (abandoned), which is 26 km east of Barrow Creek, and produced about 6000 tons (6100 tonnes) of high-grade copper ore (Sullivan, 1963). The lodes also contain zinc, lead, silber, and a small amount of gold. There are four lodes, the Main Lode, East Lode, South Lode No. 1, and South Lode No. 2; nearly all the production came from the Main Lode, which consists of an upper oxidized zone 30 m thick of limonite, azurite, malachite, and cerussite; a thin leached zone (2 m); and a lower zone about 25 m thick of secondary sulphides (chalcocite, pyrite, and chalcopyrite), with a grade of up to 24% copper. The primary ore is known only from drill holes below 90 m, and consists of pyrite, sphalerite, bornite, chalcopyrite, galena, and chalcocite; the grade is 3-5% copper, 1-6% lead, and up to 15% zinc. The country rocks are micaceous schist and amphibolite. Thomson (1950) considered that the schistosity was parallel to bedding, and that the amphibolite bodies were sills (i.e., orthoamphibolite). Sullivan (1953) concluded that the Main Lode lay along a 'discordant junction' in the country

rocks. However, there is little difference between the sequences north and south of the Main Lode, and so it may occupy a shear zone which is nearly parallel to the schistosity. The chloritic wall rocks could then have been formed by retrogression of the amphibolites. Metal ratios vary along the lode. Blanchard (1968) considered that considerable secondary enrichment had occurred above the water table (at about 30 m) during the present erosional cycle. Taking into consideration the regional pattern of deep weathering and erosion, the enrichment may be multicylic. The western end of the South Lode was opened up by an exploration shaft, but proved unrewarding. Several small occurrences of copper minerals are known in the area between the mine and Barrow Creek.

JERVOIS - BONYA DISTRICT

The Jervois-Bonya district (Fig. 2) is in the eastern part of the Arunta Block, and extends from Mount Sainthill in the west to the Jervois Mineral Field (q.v.) in the east. In this particular area, the Arunta Block may be a single tectonic entity with a simple pattern of metallogenic evolution.

The copper-zinc-lead lodes of the Jervois Mineral Field are described elsewhere in this volume.

The small copper lodes in the headwaters of Bonya Creek, in particular Bonya, Kings Legend, and Xanten, are associated with amphibolite. The Yarraman Mine, northwest of these, is close to a major fault, and contains lead as well as copper.

Scheelite occurs throughout the entire Jervois-Bonya district. Early discoveries included

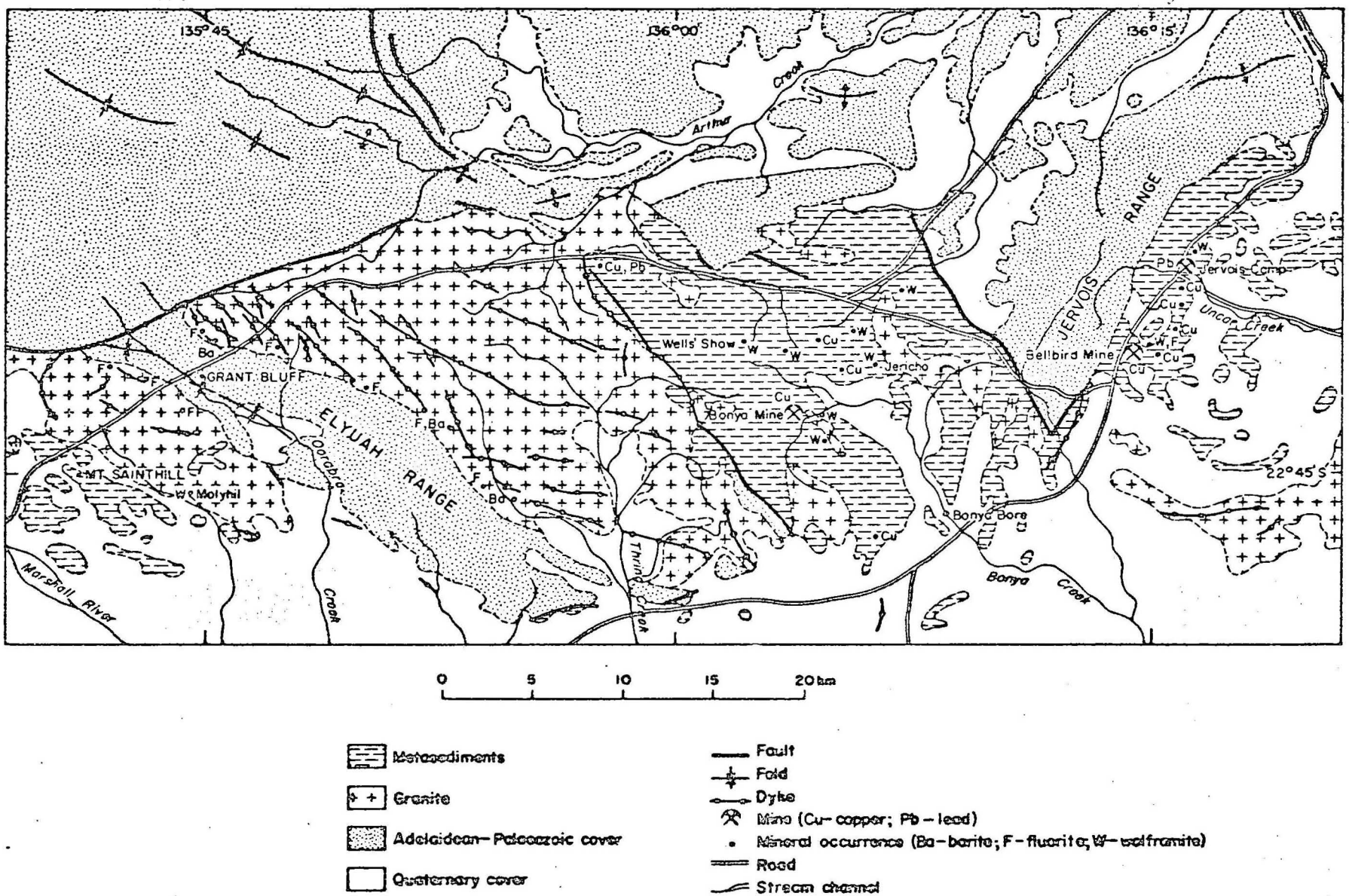

Fig. 2 Generalized geological map of Jervois - Bonya District, Arunta Block, N.T

Modified from Huckitta 1:250 000 geological sheet (First edition, 1964), published by Bureau of Mineral Resources

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Wells' Scheelite Show (Nye and Sullivan, 1942), and several occurrences (including a quartz-fluorite-scheelite body) were reported by Robertson (1959); however, most of the scheelite has been located by intensive prospecting since 1969. The lodes occur in calc-silicate host rocks, and granite or pegmatite is generally present nearby.

The Molyhil deposit occurs in a small block of calc-silicate rock, probably fault-bounded, within the Jinka Granite. The scheelite has a patchy distribution over an area of about 1 km^2. The area is poorly exposed, and no detailed mapping has as yet been done. Molybdenite and allanite have been found adjacent to the main scheelite lode.

The scheelite deposit at Jericho is typical of those in the headwaters of Bonya Creek. The lode consists of coarse scheelite disseminated in skarn in a calc-silicate and pelite sequence. A small body of pegmatite crops out in the open cut, and a larger pegmatite dyke crosscuts the country rock about 20 m from the open cut. The lode also contains a minor amount of chalcopyrite at depth, and this has altered to cuproscheelite and malachite near the surface.

Several veins of quartz-fluorite-barite, with traces of chalcopyrite, cut the Jinka Granite northwest and southeast of the Elyuah Range (Fig. 2) (Ivanac and Pietsch, this volume). The veins consist of alternating bands of quartz and fluorite, indicating several episodes of deposition (Hill, 1972). Hill (op. cit.) noted that the veins are restricted to

the immediate vicinity of the Elyuah Range, which is a large syncline of Upper Proterozoic to Upper Cambrian sediments that lie unconformably on the Jinka Granite, and he also observed that, at one locality, the veins cut the Mt Cornish Formation, at the base of the synclinal sequence. It is probable that the veins were emplaced during or after the formation of the syncline, in Devonian-Carboniferous time. However, it is not yet known whether the veins were introduced for the first time, or whether they were derived from older veins that had formed at a late stage in the emplacement of the Jinka Granite, and were then remobilized and injected into the Mt Cornish Formation in Late Palaeozoic time.

SOUTHERN ARUNTA AREA

The southern part of the Arunta Block is an area of complexly folded and intensely metamorphosed rocks, with few granites. The original rock-types were sediments and basic igneous rocks. In the early mining history of the area, between 1887 and 1912, gold production was dominant, but after this period, until 1961, mica production was dominant. Small deposits of copper and lead minerals were located and mined for short periods, and the present emphasis in the area is on further prospecting for base metals.

Joklik (1955) described the mica mines of the Harts Range in detail. Most of the mines produced muscovite from large pegmatite bodies which were generally localized in faults or joints discordant to the layering of the country rocks. The most

productive pegmatites were zoned, with distinct core, intermediate, border, and wall zones, and were localized in mica-rich gneiss. Some of the pegmatites also contained accessory amounts of beryl and thorium minerals. Most of the mines were in the northern and northeastern part of the Harts Range, but some were located in the hills bordering the Plenty River Plain (south of Mt Sainthill), and in the Bundey River basin, near Mt Swan (Joklik, 1955).

Gold occurs in lodes in the zone of intense deformation known as the Arltunga Nappe Complex, and also in the Arunta Complex southeast of Claraville, a few kilometres north of the deformed zone (Hossfeld, 1937a, 1937b, 1940). In both areas the lodes occupied tensional joints. In the Claraville field, the lodes were quartz-pyrite-calcite-siderite, and the gold was contained in the pyrite. In the zone of deformation (Winnecke and White Range fields) the lodes were quartz-pyrite-chalcopyrite. It is not clear whether all the lodes were introduced during the formation of the Arltunga Nappe Complex in Devonian-Carboniferous times, or whether the lodes in the deformed zone were formed by mobilization of older lodes, now represented by those east of Claraville. In both areas, mining was confined mainly to the zone of oxidation (about 20 m deep), where the pyrite had been converted to limonite and the gold was therefore more easily separated from the ore.

The base-metal deposits in the southern

Arunta area are of three types. Several small copper lodes in the Harts Range are closely associated with basic rocks (mainly amphibolite). The Pinnacles copper field (Shaw, 1970) contains a number of small quartz lodes which fill north-trending shear zones in a meta-sedimentary sequence consisting chiefly of calc-silicate rock and marble. The primary minerals are chalcopyrite and siderite, but mining has been confined to the richer secondary ore which consists mainly of malachite. The ore minerals are believed to be related to nearby pegmatites.

The third type of base-metal deposit in the area includes the recently discovered Oonagalabie deposit in the Harts Range, and other similar deposits occur throughout the Harts and Strangways Ranges. The type has a number of distinct characteristics. At Oonagalabie (I. MacCulloch, Russgar Minerals, N.L., personal communication), lead, copper, and zinc are all present, but the metal ratios vary widely. Quartz-magnetiterock and magnesium-rich minerals such as phlogopite, anthophyllite, and cummingtonite are closely associated with the deposits. Forsterite marble is also present, and generally carries sulphides. The country rock is a garnet-cordierite-quartz gneiss, commonly accompanied by orthoamphibolite. The deposits commonly contain minor quantities of other metals, such as gold at Oonagalabie and Johannsen's Phlogopite mine (Stillwell, 1943), and molybdenum at Johnnie's Reward (Shaw, 1970).

There are some similarities between the

Oonagalabie type of deposit and the Jervois lodes, in that both are closely associated with calc-silicate and quartz-magnetite rocks. However, the high magnesium content of the Oonagalabie type has not been established in the Jervois lodes, although both phlogopite and cordierite are present at Jervois (Morgan, 1959), and the chlorite in the wall rocks may also contain considerable magnesium. Similarities also exist between the Oonagalabie and Jervois lodes and the Tennant Creek lodes, which are also characterized by quartz-magnetite gangue, locally accompanied by high-magnesium chlorite. However, marble and calc-silicate rock are virtually absent from Tennant Creek, and, furthermore, the Tennant Creek lodes are generally considered to be hypogene in origin, whereas the marked stratigraphic control on the Jervois lodes, and the apparent stratabound nature of many of the deposits of the Ooagalabie type, suggest that the original concentration of metals in the latter two was syndepositional.

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