(g) 5,000 m of virtually no outcrop, probably shales;

(h) Euglo Formation, 3,000 m thick succession of sandstones and shales;

(i) Ugalong Dacite, 5,000 m of dacite;

(j) Weelah Formation: Towards the north from Burcher, intercalated between the Manna Conglomerate and the Ina Volcanics, and possibly partly a facies change of the Manna Conglomerate, a 10,000 m thick sequence of shales, sandstones, conglomerates, calcareous cherts and possibly rhyolites; resembling the Ootha Beds east of Condobolin.

The Weelah Formation contains the following:

(i) Bogandillon Chert Member, 500 m thick;

(ii) Manganiferous Shale horizon;

(iii) Darby Conglomerate Member, similar to the Manna Conglomerate and about 2,000 m thick;

(iv) Horizon of chert lenses.

All the above formations appear to be conformable with one another except the relationship between the Burcher Greywacke and the Sandal Formation which appears to be slightly unconformable.

Without any definite palaeontological data, dating of the rocks is difficult. However, from regional stratigraphic considerations it would appear that the units from the Manna Conglomerate to the Burcher Greywacke are Silurian, and those from the Sandal Formation to the Ugalong Dacite are Lower Devonian.

Pyritic dolerite sills occur in the Ina Volcanics; small stocks of diorite intrude the Banar Formation; a small granite stock occurs at Billy's Lookout in the southeast and there are other granites in the southwest.

The structure of the area is very simple: it appears to be the western limb of a sheared-out anticline adjoining the Tullamore syncline.

In a regional sense the rocks form the southern continuation of the Nymagee-Melrose belt of sedimentary and volcanic rocks.

Cu-Pb-Zn-Ag mineralization is associated with the acid volcaniclastics of the Ina Volcanics. Gold has been mined from the Banar Formation. Manganese occurs in the Weelah Formation in joints and as coatings and replacements in sandstone and shale.

Explanation of Text-figure.

Swc	—	Manna Conglomerate
Swf	—	Weelah Formation
Sbm	—	Bogandillon Chert Member
Swfm	—	Manganiferous shale horizon
Sdc	—	Darby Conglomerate Member
Swfc	—	Horizon of chert lenses
Scm	—	Cowal Member
Snf	—	Ina Volcanics
Sbf	—	Banar Formation
Sbg	—	Burcher Greywacke
Slvm	—	Blow Clear Member
Dsf	—	Sandal Formation
Def	—	Euglo Formation
Dud	—	Ugalong Dacite
g	—	Granite
Black	—	Outcrop
1	—	Shelly fossil horizon, Sandal Formation
2,3	—	Crinoid stems, Burcher Greywacke
4	—	Trilobite, Ina Volcanics

CUPRIFEROUS PYRITE DEPOSITS IN THE GIRILAMBONE BEDS, TOTTENHAM, NEW SOUTH WALES

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Cupriferous pyrite deposits at Tottenham and Albert (19 km to the southeast) occur in poorly outcropping schists and quartzites of the Girilambone Beds. The rocks have undergone greenschist facies metamorphism and are strongly deformed. The schists were originally quartz-rich sediments and basic volcanics. The schists of basic volcanic origin are restricted to the Tottenham area and are folded into the Orange Plains Anticline. This structure has been outlined by surface mapping (Skrzeczynski, 1972; Suppel, 1974) and by an aeromagnetic survey carried out by the Bureau of Mineral Resources (Rees and Taylor, 1973). Drilling in the Tottenham area has revealed a rock type not recognized in outcrop — a well foliated quartz-albite-muscovite (chlorite) schist which is believed to be the host for many of the pyrite bodies. This rock type has a trace element composition similar to that of the basic schist.

The cupriferous pyrite deposits occur in two forms: as narrow stratiform, massive pyrite bodies occurring a short distance above, or within, basic schist units in the Orange Plains Anticline area, and as cross-cutting, fissure-filling quartz reefs near Albert.

Basic schist, together with spatially related quartzite, and ultrabasic and intermediate to basic intrusives occur sporadically throughout the Girilambone Beds. It is suggested that these rocks belong to an incomplete, dismembered ophiolite complex, and that the massive cupriferous pyrite deposits which occur at Tottenham, and also at Girilambone (120 km to the north-northwest), are volcanogenic and are associated with the basic volcanics of the ophiolite complex.

"VOLCANOGENIC" MINERALIZATION AND PALAEOENVIRONMENT AT MINERAL HILL, NEW SOUTH WALES

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The Mineral Hill district, located 50 km north of Condobolin, central NSW, is one of several volcanogenic copper-lead-zinc prospects lying in or near the Silurian (?) Babinda belt in the Cobar trough section of the Lachlan Geosyncline.

Fossiliferous sediments with interbedded tuffs, volcanic detritus, ignimbrites and lahar indicate near shore deposition in shallow marine basins with a nearby, probably partially subaerial, volcanic source.

Mineralization occurs in two broad types: structurally controlled stockwork zones consisting of open space infillings and replacements in pyroclastics; and stratabound massive sulphide lenses and ferruginous cherts in sediments overlying the stockworks.

The mineralization has a crude stratigraphic zonation ranging upward through central stockworks from Py-Au, Cpy-Py to Bo-tet-sph-Ag-trace hematite and partially martitized magnetite. Overlying sediments have Py-Sph-Ga assemblages and hematitic zones. Cluster analysis of thirty elements in 15 samples from a laterally zoned section of stockwork at intermediate depth delineates element groups corresponding to a central Py-Cpy-trace molybdenite and arsenopyrite assemblage, a marginal Ga-Sph-carbonate zone, and distal unmineralized host pyroclastics. Chlorite and sericite are found in all zones and extend well beyond areas of mineralization. Adularia is present in one central stockwork area.

Fluid inclusion homogenization temperatures are bimodally distributed with peak values at 250° (considered primary) and 160°C (considered secondary).

5. GEOLOGY AND MINERALIZATION IN THE SOUTHERN LACHLAN FOLD BELT

GEOCHEMICAL-PETROGRAPHIC INVESTIGATIONS OF ROCKS FROM AROUND THE WOODLAWN Cu-Pb-Zn ORE BODY, SOUTHEASTERN NEW SOUTH WALES.

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The Woodlawn ore body, which is being developed by Jododex Australia, is near Tarago, about 45 km northeast of Canberra. It consists of massive Cu-Pb-Zn sulphide lenses, plus stringer and disseminated mineralization.

Chemical, X-ray diffraction and microscopic studies have been carried out on two hundred and fifty representative samples from diamond drill cores at various distances up to approximately 1 km from the ore body.

These investigations have confirmed the general geological description evolved during joint studies by Jododex, the Geological Survey of NSW and CSIRO Division of Mineralogy, and they have further elucidated details of rock distributions, alteration minerals and geochemical anomalies in the Woodlawn area.

The two main rock types in the vicinity of the ore are felsic volcanics, which are dominant to the south and the west of the ore, and fine-grained sedimentary rocks, which are most abundant in the immediate vicinity of the ore body and to the north. The sedimentary rocks seem to be mainly derived from the acid volcanics. Dolerite intrusions are common to the north.

There is an extensive aureole of silicification, chloritization, sericitization and stringer mineralization around the ore body, in which feldspars and primary ferromagnesian minerals are virtually absent. The main chemical changes within the hydrothermally altered rocks appear to be addition of Si, Mg, Fe, (Mn), Al, (K), Ag, Cd, Zn, Pb, (Bi), Cu, S and (Sn), and depletion of Na and Ca, with the elements in brackets showing less systematic trends.

The aureole of chemical and mineralogical anomalies can be divided into several distinct zones as summarized in Fig. 1.

Zone 1 represents the most intense alteration and may include precipitates from the metal-rich ore-forming solution. It is characterized by abundant stringer mineralization, chlorite schists and cherts, together with altered volcanic and sedimentary rocks. This zone occurs in the immediate vicinity of the massive sulphide lenses and extends deeper into the footwall under the southern parts of the ore, along what are considered to be "feeder" zones for the mineralization. The rock chemistry is dominated by high Mg and Fe values with low SiO_2 in the schists, and almost pure SiO_2 in the cherts; the altered volcanics and sediments are chemically intermediate between these extremes. Ca, Na and K contents of all rocks are very low, as evidenced by the absence of feldspars in this zone.

Zone II is a relatively extensive zone of less intense hydrothermal alteration, characterized by less common stringer and disseminated mineralization and a virtual absence of feldspars, apart from some basic rocks. Chemical changes include widespread silification of the felsic volcanics; Mg content is significantly higher than in the unaltered felsic volcanics and sediments and tends to increase towards the ore body; Na and Ca are much depleted, but K contents are fairly normal, reflecting the abundance of sericitic muscovite.

Zone III, which comprises the Central Volcanic Pile, evidently was not permeated throughout by hydrothermal solutions. It contains patchy development of chlorite-rich rocks and stringer to disseminated base metal and pyrite mineralization. Elsewhere the felsic volcanics tend to be silicified, but they generally contain albitic felspar. The chemical features of the rocks in this zone are therefore highly variable.

Outside these zones there is some silicification of the felsic volcanics and other mild chemical changes which can be ascribed to deuteric alteration and low grade metamorphism, rather than to mineralization.

We consider tht seawater descended into the volcanic pile and was heated and chemically modified to a minor degree as it circulated and ascended to the surface, where it gave rise to Zone II alteration by reaction with the volcanics and sediments. Ore formation and Zone I alteration could have occurred fairly rapidly following assimilation by this circulating seawater of highly metalliferous solutions. The latter would be analogous to those which form porphyry copper deposits and could have been generated during sub-volcanic magma fractionation and/or by extensive rock leaching at moderate to high temperatures. Explosive volcanic activity