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THE PRECAMBRIAN OROGENIC BELT OF NORTH-WESTERN QUEENSLAND

by

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The Precambrian of north-western Queensland, excluding the Upper Proterozoic or Lower Cambrian Camooweal Dolomite, which is probably intra-continental in origin, has an area of just over 20,000 square miles. The main areas of outcrop of the Upper Proterozoic strata are in the west and north-west of the region and extend into the Northern Territory, south of the Gulf of Carpentaria.

The Precambrian was mapped between 1950 and 1954 by officers of the Commonwealth Bureau of Mineral Resources, Geology and Geophysics and of the Geological Survey of Queensland. This paper is based on the results of that work. At the last A.N.Z.A.A.S. meeting, in Melbourne, a paper dealing with the tectonic units within the Precambrian of north-western Queensland was read on my behalf. This morning I am concerned with the two units which together constitute the old Precambrian orogenic belt. They appear on the wall map in blue and yellow. I regard the rocks as Lower Proterozoic in age, although earlier maps show them as Archaeozoic. Their age has not yet been conclusively established.

In the time available I can only give a brief outline of the history of the region as I interpret it. It is as follows:-

1. Rhyolites and dacites were poured out over an area of at least 7,000 square miles, for the most part on land. However, in the east the oldest strata exposed are altered interbedded rhyolites and sediments.

2. As acid vulcanicity continued subsidence gradually took place with encroachment of the sea from the east. The lavas, which at first formed great sheet flows, devoid of tuff, gradually became more varied in type. Basalt, tuff and agglomerate were interbedded with acid flows and sediments.

3. At the close of the acid vulcanicity subsidence was apparently effected by near-meridional tensional faulting about the longitude of Mount Isa - there may have been several parallel fault-zones. As a result a

several thousand foot thick succession of quartzite, with a few basalt flows, developed in the west of the area and extended into the centre of the basin. At the base of the succession, in the west, are heavy conglomerates with acid lava and granite boulders.

4. This was followed without interruption by a period of basaltic outpouring on an even grander scale than that of the acid vulcanicity. Flows spread out over not less than 10,000 square miles. Wherever now preserved the flows are interbedded with altered sediments. Some of the sediments show that the water was very shallow indeed and there may have been local temporary emergences in the west of the area. In the resulting volcanic succession basalts constitute from 80% down to 20% of the total volume. The succession attained a maximum thickness of not less than 20,000 feet.

5. While the basalts were being outpoured a gentle updoming of the central portion of the basin on a meridional axis took place, so that this zone emerged and was gradually eroded away. Detritus was probably shed mainly to the east. By the time the basaltic vulcanicity had practically ceased the underlying acid lavas had been exposed revealing extensive basic dyke swarms stretching at least 200 miles from north to south. These undoubtedly served, in part at least, as feeders to the basalts and showed the mode of extrusion to be by fissures. Superimposed on the broad anticlinal structure were four anticlinaria. These were probably accentuated as time progressed, but the sequence of evolution is not known.

6. As the anticlinaria (which are from 10 to 25 miles across) developed, sedimentational conditions became much more varied. In the south-east muds and silts, including carbonaceous muds, accumulated while farther north limestones and dolomites become abundant. At the foot of the off-shore slopes extensive limestone and dolomitic breccias developed by slumping. Isolated, but in places impressive, agglomerates show that the vulcanicity followed the usual pattern of a dying cycle. The magma by then was keratophyric and flows were rare.

7. Thin-bedded carbonates, shale and sandstone accumulated to a thickness of at least 5,000 feet. These, together with some overlying arenaceous sediments, mark the close of the eugeosynclinal cycle. The eugeosynclinal pile has been called the Argylla sequence.

8. Moderately strong meridional folding, with north-west and north-east striking shear faults due to east-west pressure, and uplift, completed a mild orogeny, apparently unaccompanied by granite.

9. After a period of erosion of unknown duration, but in the course of which a topography with high relief had time to develop, subsidence took place to the west of the previous main region of accumulation. The subsidence was effected, in part at least, by a series of near-meridional tensional faults. Cross-warping and faulting also served to deepen the newly formed basin. Sediments were contributed from both the recently formed tectonic land to the east and the old land mass to the south and west.

10. Sediments accumulated with but minor and local interruptions until a maximum of at least 40,000 feet thickness had been laid down. At first they were primarily medium-grained arenaceous, with subordinate silty, sediments but later they became finer, more argillaceous and included interbedded carbonate-rich strata. The type of sediment varied considerably with its relationship to the source areas. Conglomerates are important along the east of the main basin, adjacent to the tectonic land. These contain pebbles and cobbles of acid and basic lavas.

11. We do not know how far east the sediments extended but probably they finally covered the whole of the old eugeosynclinal sediments and lavas. Certainly the latter were at some time covered in places by up to at least 6,000 feet of quartzite and the grade of metamorphism suggests rather deeper burial than this.

12. The main depositional basin to the north of Mount Isa had the magnitude, both in space and time (as indicated by the thickness of sediments), of a geosyncline but to the west and south deposition may have been on more or less stable shelves. Throughout the whole of the stratigraphic column in the geosyncline there are only a few hundred feet of lavas and pyroclastics so that the geosyncline would be, in Stille's and Kay's terminology, a miogeosyncline. The strata in the miogeosyncline have been named the Waggabundi sequence.

13. At some stage late in the miogeosynclinal cycle of sedimentation a narrow meridional trough developed between the craton or foreland and the site of the earlier eugeosyncline. In it collected some 10,000 feet of shales and siltstone including dolomitic and carbonaceous shales. These subsequently became the host rocks for the great Mount Isa lead-zinc-silver and copper orebodies.

14. The miogeosynclinal sedimentation was terminated by the onset of lateral compression from the same direction as that which had previously folded and faulted the eugeosynclinal strata. The rocks of the Waggabundi

sequence were strongly folded, dips commonly being 60°-70° in the linear synclinal areas; the anticlinal zones are generally more broadly folded. Conjugate shear faults also developed, particularly in the competent arenaceous strata.

15. The deeply buried eugeosynclinal strata were much more severely deformed and metamorphosed. The carbonate rocks in particular flowed and deformed plastically. Cleavage and schistosity were extensively developed in the Argylla sequence but are not so readily discernible in the Waggabundi sequence. Overthrusting occurred in the longitude of Mount Isa and south of Cloncurry.

16. Accompanying the lateral compression was a most extensive introduction of granite. The granites conform to the usual type of synorogenic granite - coarsely porphyritic, foliated, diverse in composition due to widespread assimilation and limited granitization.

17. The syncrogenic granite was followed by a fine to medium, even-grained late- or post-orogenic granite.

Associated with the granitic activity metamorphism and metasomatism, particularly of the carbonate rocks, took place on a regional scale. Lavas were recrystallized; schists, gneisses and granulites were formed and the carbonate-bearing rocks were converted to calc-silicates. The regional metasomatism expressed itself in most extensive albitization and scapolitization. The zone of scapolitization is one of the most extensive in the world. Skarn rocks were formed locally. The Mary Kathleen uranium deposit occurs in such a skarn rock zone.

The time interval between the two granites is not known, nor is the precise contribution of each granite to the metamorphism and metasomatism of the country rocks known. It is of interest to note that though both granites intrude the Argylla and Waggabundi sequences the contact effects in the latter are generally negligible while they are profound in the former.

18. Uplift completed the orogenic cycle and there is no record of any later profound tectonic movement in the orogenic belt. Some post granite faulting has taken place

19. The erosion of the elevated mountain region gave rise to sediments in the west, on the craton, and presumably to the east but the latter are now concealed beneath Mesozoic sediments of the Great Australian Artesian Basin. Upper Proterozoic vulcanicity along the south of the Gulf of Carpentaria does not appear to be related in any way to the Lower Proterozoic orogeny.