MESYUARAT PERSATUAN
(MEETINGS OF THE SOCIETY)

R.L. STANTON: An alternative to the Barrovian interpretation? Evidence from stratiform ores.

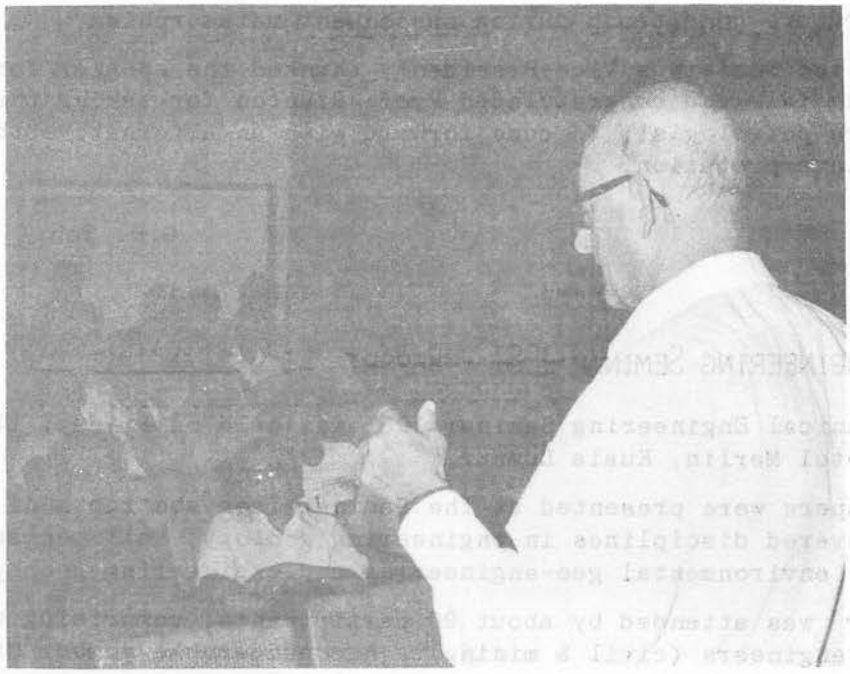
On the 16th Feb. 1981, about 60 members were present at the Lecture Hall, Dept. of Geology, University of Malaya, to listen to a talk by Prof. R.L. Stanton from the University of New England, Armidale, NSW, Australia, which featured the provocative title "An alternative to the Barrovian interpretation? Evidence from stratiform ores". This joint meeting of the Society with the Geology Dept., University of Malaya was chaired by Prof. P.H. Stauffer. Prof. Stanton, incidentally, is just completing his 3-year term as External Examiner in Applied Geology to the University of Malaya.

Prof. Stanton started off his talk by emphasising that recent work has shown that, in at least some instances of regional metamorphism, metamorphic diffusion has been restricted to relatively minute distances (of the order of 1.0 mm and much less), that there is no clear, direct, evidence of prograde metamorphic reactions, and that metamorphic equilibrium does not appear to have been attained through even very small domains.

He elaborated that more precise studies, on the scale of the microscope and particularly of the electron microprobe, are beginning to place severe limits on the distances involved in metamorphic diffusion. Limits on diffusion set limits to the extent to which minerals may react and this in turn limits the extent to which the metamorphic system can approach equilibrium. Indeed clear microscopical evidence of mineral reaction is hard to find and there is no single photograph available illustrating the destruction of ore mineral and the concomitant development of another.

He pointed out that the almost general absence of direct evidence of reaction has led some observers to suggest that metamorphic rocks may attain their mineral assemblages directly, rather than by a series of mineral reactions, and hence without passing through each successive grade. Coupled with doubts concerning the reality of many postulated metamorphic reactions are doubts on equilibrium. The preservation of zoning in garnets, revealed so spectacularly by the electron microprobe, has been an early indication that, even at high grades of metamorphism, equilibrium may remain unattained in a single crystal. Further, evidence of the preservation of compositional inhomogenieties in other minerals, including sulphides, is now mounting, indicating that compositional equilibrium may not have been attained even in the most sensitive crystal structures, and even where these are subjected to the highest grades of metamorphism.

Then Prof. Stanton went on to show that a number of stratiform ore bodies and their immediate metapelitic environments exhibit very large, seemingly "disequilibrium", assemblages of regional metamorphic index materials. Whole rock analyses of different lithological units and bands of Gorob (S.W. Africa), Mount Misery (N. Queensland), Broken Hill (New South Wales), and Pegmont (NW Queensland) show these to vary in composition from one to another very substantially over very short distances,



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even though the original rocks in all cases appear to have been pelitic. The significance of this is that differences between metamorphic mineral assemblages may be entirely a result of variation in bulk composition of the parent rock, and need not represent variation in temperature and pressure at all. It also indicates that the metamorphic zones described by Barrow and thought by him to reflect changing intensity of thermal metamorphism, could in fact quite easily result from subtle but systematic compositional changes in the pelitic rocks concerned.

He added that evidence of stratiform ores now suggests that metamorphic minerals in general might represent essentially in situ transformation of earlier sedimentary - diagenetic percursor materials. It is concluded that the fluctuating seafloor interplay between warm, acid, concentrated hydrothermal waters with cold, alkaline, dilute seawater associated with stratiform ore formation, together with diagenetic processes leads to the formation of a wide range of clay, chlorite, mixed-layer clay and clay/chlorite percursor materials and hence, later, to the broad spectra of metamorphic minerals associated with some stratiform ores. The environments of stratiform ores such as those described indicate that regional metamorphic zones in pelitic rocks may, in at least some cases, stem from variation in clay and related mineral assemblages consequent upon variation in the nature and conditions of sedimentation. It is suggested that such ore environments may thus provide a clue indicating that zones of regional metamorphic minerals such as those described by Barrow in the Daldadrian rocks of Scotland may, in at least some cases, reflect facies of clay and clay-chlorite

mineral sedimentation on the relevant shelf, rather than variations in pressure-temperature conditions during subsequent metamorphism.

T.T. Khoo, the Society's Vice-President, thanked the speaker for a most stimulating talk and congratulated Prof. Stanton for taking the bold stand, as an ore petrologist, to come forward with an alternative to the Barrovian interpretation.

G.H. Teh