to those of later time, can be accounted for in part by gradual changes in the compositions of the atmosphere and oceans and in part by the depth of erosion.

Methods of study used in younger rock groups are all useful in the Precambrian, but extreme metamorphism over wide areas, more abundant igneous intrusive masses, and a dearth of fossils useful in correlation make the interpretation of the record less certain.

Methods of classification and naming recommended by the American Commission on Stratigraphic Nomenclature are now being adopted by Precambrian geologists, some of whom have assisted in their formulation. This should lead to clearer understanding and better communication.

GINSBURG, R. N., and SHINN, EUGENE A., Shell Development Company (A division of Shell Oil Company), Exploration and Production Research Division, Houston, Texas

DISTRIBUTION OF THE REEF-BUILDING COMMUNITY IN FLORIDA AND THE BAHAMAS

Luxuriant growths of reef-building corals and associated biota are characteristic of easterly facing margins of the Florida and Bahamas platforms. Along the eastern margins the reef community is most luxuriant and continuous seaward of islands; it is absent or poorly developed where islands are absent. The reef community is absent along almost all the western margins of the platforms and its few occurrences seaward of islands or shoals are small, discontinuous, and without the variety and vitality of the eastern examples.

The reef community favors the eastern margins because wave agitation and circulation of oceanic water that promotes its growth is more intense there than on the western margins. The western margins are unfavorable because water from the platform interiors, warmer and saltier than normal, is moved westward across them by the prevailing easterly winds.

The most luxuriant growths of the reef community are seaward of islands because the islands protect these areas from unfavorable currents. The islands prevent the existence of the normal cross-platform currents that produce bottom-sediment movement (oölitic sands) unfavorable for the reef community. The islands shield areas seaward of them from tidal runoff of platform-interior water that is inimical to the growth of the reef community.

Can these "principles" be applied to ancient reefs?

GOLD, DAVID P., Loyola College, Montreal, Quebec Canada

SOME MINERALS FROM THE OKA ALKALINE COMPLEX, OKA, QUEBEC

The carbonate rocks of the Oka complex contain abnormally high amounts of Zr, Nb, Ce, La, Nd, Sr, Ba, P, Mn, Ti, Na, K, F, S, and Cr, and give rise to an impressive array of unusual and rare minerals. Sixty-five minerals have been so far identified from the alkaline rocks and carbonatite at Oka.

As in most alkaline complexes the paucity of silica is reflected in the low silica type of minerals they contain, by the presence of oxide minerals of iron, titanium, phosphorus, and niobium, and undersaturated silicate rocks. Substitution of elements in some of the minerals is inferred from their chemical composition, and probably accounts for their anomalous optical properties. The constituent minerals of the silicate rocks are commonly characterized by high alkali, alumina, manganese, and low silica content, with in some cases unusually high substitution of alumina for silicon. In the oxide minerals niobium commonly substitutes for titanium.

GOODWIN, A. M., Ontario Department of Mines, Toronto, Ontario, Canada

RELATIONSHIP OF MINERALIZATION TO STRATIGRAPHY IN THE PRECAMBRIAN VOLCANIC-SEDIMENTARY COMPLEX, MICHIPICOTEN AREA, ONTARIO

The Michipicoten group of older volcanic and sedimentary rocks comprises flows and pyroclastic rocks of andesite-rhyolite association together with conformable zones of clastic sediments and banded iron formation. Later intrusive rocks consist of dacite, granite, and diabase.

The typical volcanic cycle progressed from (1) widespread and prolonged extrusion of andesite-basalt flows, through (2) violent ejection of rhyolite-dacite pyroclastics, to (3) extensive hot-spring and fumarolic activity. Banded iron formations are considered to represent chemical products of this last stage. Development of the Michipicoten group is viewed as a continuous process which, once initiated, proceeded through explosive, erosional, chemical, and intrusive phases to produce a complex family group of which the members, although each possesses unique characteristics, are related by common volcanic heritage.

Iron, gold, and base metal deposits occur within, or marginal to, the principal acid volcanic zones. In general, mineralized centers coincide with what may be reasonably interpreted as centers of maximum explosive volcanic discharge. In this manner, siderite-pyrite members of banded iron formation overlie coarse acid pyroclastic zones; gold and base metal deposits occur within, or marginal to, nearby porphyry intrusive stocks. Acid extrusive rocks, porphyry intrusions, and mineral deposits are considered to have a common, sub-volcanic derivation and to owe their present stratigraphic association to common generative volcanic processes.

GRAHAM, A. R., BUCHAN, R., and LEE, C. R., Falconbridge Nickel Mines Limited, Thornhill, Ontario, Canada

MILLERITE AT STRATHCONA MINE, SUDBURY DISTRICT

Millerite occurs in relative abundance with chalcopyrite, pentlandite, violarite, pyrrhotite, and sparse pyrite in discontinuous stringers and disseminations along fractures and joints in leucocratic and amphibolitic footwall gneisses near the norite contact more than 3,000 feet below the present surface. Some roughly equidimensional masses up to 8–10 centimeters in size show splendent crystal faces and excellent cleavages barred by polysynthetic twinning. Gangue minerals include sodic and potassic feldspar, quartz, amphibole, epidote, garnet, and biotite. Partial chemical analysis on hand-picked cleavage fragments of millerite gave 62.0% Ni, 0.04% Cu, 0.33% Co, and 1.44% Fe. The x-ray powder diffraction pattern gave $a_0 = 9.622 \pm 0.006$Å and $c_* = 3.150 \pm 0.005$Å. Primary origin by crystallization from a hot sulphur-rich iron-poor fluid is proposed from the environmental evidence available.

GRIFFITHS, J. C., The Pennsylvania State University, University Park, Pennsylvania

AN ALGORITHMIC PROGRAM FOR THE ANALYSIS OF DETRITAL RESERVOIR ROCKS

The objectives of this program are essentially fourfold: (1) the data gathering process leads to a quantitative petrography and thence, via a model, to petrogenesis; (2) the data analysis leads to specification of the relationships between reservoir behavior and variation in the petrographic properties; (3) the analysis, suitably extended, leads to a measure of relationship between logging responses and variation in the petrographic properties; and (4) the analysis may be used to identify reservoir rocks and differentiate them from similar appearing barren rocks. Such objectives encompass an interpretative petrology, a means for predicting and controlling reservoir behavior, a means for selecting the important logging parameters and a possible interpretation of their role in reflecting variation in rock properties and, by identifying the reservoir rock, may form the basis for an exploration program.

This program has been used for the analysis of eleven sands either actual or potential reservoir rocks from the Appalachian Province; they include representatives of the Devonian (Chipmunk, Bradford, Lewis Run, and First Venango sandstones), Mississippian (Berea, Weir, and Maxton sandstones), Pennsylvanian (two Cow Run sandstones, and a middle Kittaning sandstone), and Permian (the Waynesburg sandstone) systems.

The most important properties in each case are grain size, size-sorting, and the cementitious constituents, carbonate and silica cement. There are two dominant types of sandstone, the one in which grain size and (or) size-sorting act as the main controls and the other in which the size and size-sorting is subordinate in importance to the cementitious materials. When the dominant properties are size and size-sorting, channeling is the most important problem in production and secondary recovery. When the dominant features are the cements, then combinations of acidizing and hydraulic fracturing are likely to be important palliatives.

Those sandstones in which the cements are most important are sporadic in occurrence and, under present conditions, would be difficult to impracticable to locate, whereas, in those sandstones in which grain size and size-sorting are the dominant characteristics, it should be possible to detect gradients which could form exploration guides.

GUTSCHICK, R. C., University of Notre Dame, Notre Dame, Indiana

Comparison of the Devonian-Mississippian Boundary Sequence of Western Montana with the Appalachian Basin

There is remarkable similarity between the Devonian-Mississippian Sappington formation of western Montana and the Ohio shale-Bedford shale-Berea sandstone-Sunbury shale sequence of the Appalachian basin. The comparison is based on composition, color, and ordered succession of lithologic types, sedimentary structures such as channeled sand- and siltstones, ripple marks (oscillation, current, and interference), and cross-stratified sand- and siltstones, flow rolls (ball and pillow structures), paleogeographical and paleoecological interpretations, and fossils. Both areas bear a similar relation to the Cordilleran and Appalachian geosynclines, respectively.

In each case the strata involve a lower dark shale of late Devonian age, intermediate light-colored shales and siltstones or sandstones of Mississippian age, and an upper dark shale. This relationship can be summarized as follows:

	Cordilleran Geosyncline W. Montana			*Appalachian Basin*
Mississippian	Sappington Fm.	Unit I	Black shale	Sunbury Sh.
		H	Siltstone	Berea Ss.
		G F	Shales and Siltstones	Bedford Sh.
Devonian		E	Algae (oncolites)	
		D	Shale (thin)	
		C B A	Black shale Black shale Black shale	Ohio Sh.

One significant difference is in the presence of an algal (oncolite)—sponge biostrome (Unit E) which has wide distribution in the western area that is apparently absent in the Appalachian basin.

GWINN, V. E., and BAIN, D. M., McMaster University, Hamilton, Ontario, Canada

Penecontemporaneous Dolomite in Upper Silurian Cyclothems, South-Central Pennsylvania

Composition of carbonate rock units in carbonate-mudstone cyclothems in the Tonoloway and Wills Creek formations (Swartz, 1955) appears to be positively correlated with types of primary structures, amount of organic material, state of oxidation of iron, relative abundance of fossils, and presence or absence of evaporite mineral pseudomorphs.

Dolomitic carbonates have a preferred association with the following: thin bedding and internal lamination, cut-and-fill structures, mud-cracks, and possible algal-mat lamination; higher proportions of siliciclastic detritus; and a low organic matter content as expressed by light color and usually an absence of fossils. Some dolomite beds have carbonate pseudomorphs after anhydrite and halite.

Limestone elements of the cycles, on the other hand, have these general characteristics: thicker bedding, general absence of thin laminae, and other structural evidence of shallow water or subaerial exposure seen in the dolomites; less siliciclastic detritus; more frequently fossiliferous, with more varied fauna; darker color with higher organic content; and iron generally present in the form of pyrite.

The excellent correlation of four features, primary structures, organic content, oxidation-reduction phenomena, and the amount of non-carbonate detritus, with carbonate composition appears to point to the operation of two causal factors in the repeated depositional-compositional cycle from calcareous to dolomitic carbonate: (1) shoaling of the water; and (2) a concomitant increase of salinity. Following this tentative conclusion, it appears that the dolomite are penecontemporaneous in development. The necessary Mg^{++} may have been derived from the relatively more saline waters present at the end of most of the cycles, with the dolomite forming while the carbonate debris was bathed in the basin waters during or immediately after deposition during earliest diagenesis. No "typical" criteria of secondary dolomitization have been observed.

Additional study will be directed to analysis of boron content of clays in the intercalated mudstones, perhaps to carbon isotope fractionation in the cycles, and to the origin of a bed-thickness cycle superimposed on the compositional cycles (Lacey, 1960), which is not obviously correlated with the compositional cycle.