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Geological Evolution of the Earth During the Precambrian

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With 78 Figures

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Preface

Progress in Precambrian geology has been exceptionally great, indeed quite striking for geologists of the older generation; only some 30–40 years ago the Precambrian appeared as an uncertain and even mystic prelude to geologic evolution. Even the very name – Precambrian – means some indivisible unit in the early history of the Earth, the beginning of which is poorly known. At the same time it was obvious that the Precambrian formations are of extremely varied and complex composition and poor knowledge and lack of reliable methods of division and correlation were to blame for the lack of significant progress in studies of this early evolutionary stage of the planet. Certainly, even at the very start of Precambrian studies, the results obtained were quite promising, lifting as they did the mysterious veil over the regional Precambrian; but they presented no general realistic picture of this early stage in the Earth's evolution at that time. Recently, this situation has completely changed, due to new methods of study of the older formations, and due also to the refinement of some well-known methods, in particular of division, dating, and correlation of "silent" metamorphic strata. Application of different isotope methods of dating was most important in providing objective rock age and thereby the age of geologic events recorded in these rocks. Thus it became possible to reconstruct the oldest geologic period of our planet.

The title of this book, at first sight, represents a certain tautology, but geologic history can only be clarified by study of the rock records and the successions in the formation of these rocks. The oldest rocks cropping out in the Earth's surface are isotopically dated at 3.7–4.0 b.y. These rocks are, in fact, older in reality and these values characterize not the time of their formation, but the time of their transformation (metamorphism), and the oldest rocks formed during the time the Earth acquired the planet shape are not yet known for certain. The geologic evolution of the planet since $\sim$ 4.3 m.y. approximately and up to 0.57 b.y. (the beginning of the Cambrian period of the Paleozoic Era) is the object of the present study. This interval of 3.7 b.y. embraces more than 85% of the total geologic evolution. It will be shown that certain traces of still earlier events are recorded in the rocks of the Earth, corresponding to the so-called "pre-geologic" stage in the Earth's evolution (4.5–4.2 b.y.). These events, however, can only be speculated upon by indirect evidence, by analogy based on data of planetary cosmology.

Naturally, the knowledge of a very long period in the Earth's history has exceptionally important scientific implications in its theoretical and philosophical aspects. Recent studies reveal that many of the regularities poorly based or uncertain for Phanerozoic time could become much clearer after analyzing data on the Precambrian time. The studies of the older formations revealed new, previously unknown general regularities and showed important evolutionary relations of different geologic phenomena and processes; in particular, these studies provided a possibility of determining certain trends in changes of lithogenesis, magmatism, and tectonics through time. As a result we can evaluate more exactly the validity in applying the concept of actualism in studies of geologic processes. Finally, Precambrian studies are of exceptionally great economic importance, for the oldest rocks are related to large, unique mineral deposits, many of which occur only in the Precambrian complexes of certain age and structure.

This book gives a brief outline of Precambrian history in the light of the data now available and an attempt is made here to determine certain general regularities in the evolution of the outer shells of the planet: the Earth's crust, hydrosphere, and atmosphere. Naturally, different aspects of this problem are not adequately discussed here; many phenomenae are still poorly known; the author's interests, scope of study, and knowledge must also be taken into account. This book is by no means a summary or a compilation; the problems discussed here are those with which the author was concerned personally. Primarily these are the problems of the Precambrian subdivision, the evolution of sedimentogenesis, of tectonic structures and of larger elements of the Earth's crust, the problems of periodicity of tectogenesis, the relations of tectonic processes and magmatism. Many more problems of Precambrian geology are also discussed, for instance the origin of the oldest astroblemes, their appearance on the Earth's surface, certain peculiar aspects of origin of glaciations, the possible causes of changes in organic evolution. In the final chapter an attempt is made to sum up all data on the Precambrian with a conclusion on a directed and irreversible geologic evolution of the planet.

Some other generalized works of the author have appeared earlier. Data on the older formations of the Northern continents were analyzed in the book *General Stratigraphic Scheme of the Precambrian* (Salop 1973a), of which a revised and enlarged version appeared in English (Salop 1977a). The Precambrian of Africa is discussed in detail in a separate book that was also recently published (Salop 1977b). Some aspects of the Precambrian of Australia and South America are examined in papers that are in preparation. Here are also included the results obtained in the works mentioned above and the data that have become available recently; in some cases they introduce appreciable changes to the earlier conceptions. At the same time, many concepts elaborated earlier were examined more fundamentally, and many new ideas are also suggested.

This book is addressed to Precambrian specialists, as well as to a wider readership among geologists, post-graduates, and students. The author hopes also that it will be of interest to scientists of different branches, to naturalists in particular with interest in the geologic evolution of our planet.

In the book the isotope datings are given in accordance with the decay constants $\lambda_{^{238}U} = 1.5369 \cdot 10^{-10} y^{-1}$, $\lambda_{^{235}U} = 9.7216 \cdot 10^{-10} y^{-1}$, $\lambda_{Rb} = 1.39 \cdot 10^{-11} y^{-1}$, $\lambda_K = 4.72 \cdot 10^{-10} y^{-1}$, $\lambda_{\beta K} = 0.557 \cdot 10^{-10} y^{-1}$. The U-Th-Pb or Pb-Pb datings given in the book are to be multiplied by a coefficient of 0.990, the Rb-Sr datings by 0.978, the K-Ar datings are to be related to the age interval: 0.4–1.0 b.y. by 0.975; 1–1.5 b.y. by 0.978; 1.5–3.0 b.y. by 0.968 and 3.0–5.0 b.y. by 0.963 (Zykov et al. 1979) in order to bring them into accord with the now recommended standard decay constants ($\lambda_{^{238}U} = 1.55125 \cdot 10^{-10} y^{-1}$, $\lambda_{^{235}U} = 9.8485 \cdot 10^{-10} y^{-1}$, $\lambda_{Rb} = 1.42 \cdot 10^{-11} y^{-1}$, $\lambda_K = 4.692 \cdot 10^{-11} y^{-1}$ and $\lambda_{\beta K} 0.581 \cdot 10^{-10} y^{-1}$). The approximate values thus obtained differ from the ones given in the book by insignificant figures (for Pb-methods ca. 1%) and they in no way affect the geochronologic boundaries accepted in the book, especially if a general scattering of values related to geologic factors is taken into consideration. The Rb-Sr dating is obtained by whole rock isochron analysis (except in cases where a special reservation is made).

Leningrad, August 1982

L. J. SALOP

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Chapter 1 General Problems in Division of the Precambrian

I. Methods and Principles of the Precambrian Division

Rocks and their assemblages or rock records have long been the object of geologic studies. Many pages of this record have not been preserved, and many of those known have not been understood. Historical geology aims at deciphering these pages recorded in an unknown language, at reconstructing their general sequence and clarifying the contents of the buried pages. In reading these rock records geologists apply many different methods and theories their own science, as well as of many branches of the natural and physical sciences. These methods, refined with time, lead to progress in geologic science as a whole and in studies of Precambrian geology in particular. We face great difficulties in determining the succession of rock record studies or the succession of occurrence and origin of rocks even within a relatively small area. The determination of synchroneity of events imprinted in rocks of different remote areas becames much more difficult. How is this problem to be solved?

Firstly, some peculiarities exist in geologic science. Geologic study in any region starts with the accumulation of observation data which can conventionally be called facts; these data are then compared and analyzed, and result in a general picture of a certain process or event, for instance, the scheme of a normal sequence of rocks or of a geologic map of an area. Usually these reconstructions are called "factual material". In reality they represent results whose validity depends to a great extent on the natural characteristics of the area (its exposures, rock preservation, etc.), on study methods, on the capability, knowledge, and experience of the researcher, on up-to-date scientific data, and on many more factors. Thus, it can be regarded as "secondary" factual material, under constant revision and investigation. However it should be considered as factual, for new data enlarge rather than refute the old, as the history of research shows.

The next phase in geologic study is the elucidation of "empiric regularities", situations recurrent in different areas, revealed, for instance, by the existence of definite and specific paragenesis of rocks (formations) in succession of origin, by the presence of common tectonic patterns, by the manifestation of metamorphism etc. To establish the empiric regularities, which are of exceptional importance the worker must be able to compare at first sight uncoordinated data (the "primary" and "secondary" facts) and examine these data from different angles. This co-ordinated thinking is both necessary and valuable in geologic knowledge. Many geologic conceptions, including those presented here, are empiric generalizations.

The greatest achievement of geologic knowledge is to found empiric regularities on results from different natural and physical sciences. The theoretical understanding of factual data and empirical generalizations can be both inductive and deductive, but in both cases (in the latter in particular) it is the result of intuition, that is the insight of a researcher based on experience and characteristic thinking. At first sight it seems that empiric regularities based on theory lead to a law – the last and final phase of knowledge. Experience, however, proves that this is not the case, for many facts regarded as geologic "law" appeared to be a hypertrophic particular case, explained by erroneous and misinterpreted data of other sciences.

It seems, after presenting these reflections that we have no grounds to be optimistic. Nevertheless, it is impossible to deny a continuous and accelerated progress in geologic knowledge. Certainly we must never forget the relativity of our knowledge with its simultaneous expansion and investigation. Moreover, the possibility of errors is to some extent limited by the very existence of many facts (observations) which have a common or similar interpretation.

We now turn to the division and correlation of the events of the distant past and some peculiarities of methods applied in Precambrian global rock correlation will be briefly discussed.

1. Paleontological Methods

The problem of age and, thus, of stratigraphic correlation of the rocks of Phanerozoic strata is in most cases solved by paleontological (biostratigraphic) methods. In the case of Precambrian strata these methods are of limited application. The oldest strata generally lacks any determinable organic remains, and in the younger Precambrian sedimentary strata, where the microscopic and sub-microscopic remains of blue-green algae and bacteria are principally registered, their stratigraphic value is not quite clear.

In the Precambrian carbonate sediments with an age of 2400 m.y., phytolites are abundant, the products of the activity of blue-green algae and bacteria; sometimes they build extensive, thick horizons or large bioherms.

Single structures and forms of phytolites are also encountered in the strata older than 2800 m.y. (probably starting from 3400 m.y.). Phytolites, including stromatolites (columnar, tabular, nodular, and shelly forms), oncolites (concentrical, commonly small forms) and catagraphies (ornamented microstructures), do not represent the remains of organisms but rocks formed by carbonate precipitation on the algal mucus influenced by primitive microflora and partially by processes of metabolism. Thus, strictly speaking, the use of phytolites for stratigraphic correlation cannot be regarded as a paleontological method; that phytolites can be the subject of so-called parapaleontology and of lithology is more close to the truth. Studies reveal that the form of phytolites and, to some extent, their inner structure, strongly depend on the facial environment of sedimentation, but at the same time the changes in phytolites with time are likely to be due to evolution of the organisms themselves and also to the growth of population (biomass) accompanying it.

Soviet workers (Krylov, Korolyuk, Komar, Semikhatov, etc.) have elaborated the classification of stromatolite structures and have given Latin names to their different forms similar to the binar terms of biological and paleontological classification. They also outlined a vertical zonation in distribution of different forms of phytolites that is likely to be followed in many (even distant) areas. Thus, in the Upper Precambrian four stromatolite and microphytolite complexes were recognized, which are designated by ordinal numbers (starting with the oldest one) or by the names Lower Riphean, Middle Riphean, Upper Riphean and Vendian. Later, the still older pre-Riphean (Aphebian) stromatolites were also studied, but no complexes were determined among them.

At first it was suggested that the stromatolites and microphytolites typical of phytolite complexes occur only at definite levels, but further studies revealed that many of them (or even all of them) are of much wider vertical range of distribution. The regularity earlier established is only expressed statistically: certain phytolites mostly occur in rocks of definite age and composition; and also a vague tendency toward a change of complexes singly in the course of time. At the same time these complexes are characterized by a combination of stromatolites mainly differing from each other not by outer shape, i.e., not by group composition, but by the microstructural features which are taken as the base for determination of forms ("species") in the conventional classification of stromatolites. The microstructural features, however, do not necessarily reveal the primary structure of phytolites, but are in many cases due to the chemical and physical environment of sedimentation and to the epigenetic processes of recrystallization. Moreover, the systematics of formal classification of phytolites are diffuse and seldom applied, and thus a subjective determination becomes possible. These obstacles to the use of phytolites in stratigraphy lead to many errors in correlation. Recent works (Salop 1973 a, 1977 b, Hofmann 1977, Preiss 1977, Playford 1979, etc.) show that phytolites can mostly be used for correlation of monofacial deposits within relatively small areas (sedimentation basins). Global correlation is not possible with the help of phytolites.

In Precambrian rocks younger than 1600 m.y. various phytofossils, among them the acrytarchs – planktonic unicellular algae (?) – are of the greatest stratigraphic importance. In the youngest Precambrian rocks situated near the Cambrian boundary, well-preserved traces of various nonskeletal organisms and remains of multicellular algae are reported.

2. Isotope (Radiometric) Methods

These methods appear important for Precambrian stratigraphy, despite the fact that sometimes the values obtained admit different interpretation, as they can reflect the time of different events and even the time range between the last and previous events. In the case of recurrent superposition of thermal and other processes resulting in intensive isotope migration, the time of formation or early transformation of rock can only be determined approximately by the so-called relict datings obtained from detailed geochronologic studies.

In dating rocks the following methods seem to be the most valuable: lead isotope (U-Th-Pb), Rb-Sr isochron, and lead isochron (Pb-Pb), as there is a certain possibility of inner control of isotope migration with the above-mentioned methods. However, the general limitations of isotope methods also apply to these in many cases in determining the time of early events. If the rocks are of high grade and recurrent metamorphism the isotope methods only indicate the time of the last strong transformation of the rocks, when isotope equilibrium was established anew and homogenization in isotope distribution in cogenetic rocks (minerals) took place.

The K-Ar widely accepted method usually gives only the time of the latest thermal event. By this method it is possible to obtain the true age of the rocks (or minerals) which were formed on or shortly below the Earth's surface and were never later subjected to any (even slight) long heating or deformation. The K-Ar datings usually give that period of time when agents of the deeper parts of the Earth's crust (higher temperature and pressure) stop acting; they do not greatly change the rocks but initiate the loss of argon. This stopping of metamorphism (and cryptometamorphism) is mainly explained by uplifting of the crust blocks above a critical level that differs for dating of different minerals (for biotite, for instance, it coincides approximately with a geoisotherm of 300 °C). In cases when uplift of the Earth's crust terminates the tectono-plutonic cycle, the K-Ar method roughly shows the time of folding, metamorphism, and plutonism.

However, in cases where argon is lost from the crystalline lattice of minerals under extremely high pressures (that is at a great depth), it can be preserved for a long time in defects of crystals or in rocks. If there was no significant uplift of the Earth's crust at that time, then in later metamorphism argon could have been held again by the crystalline lattice and then the age of minerals (rocks) analyzed will not differ greatly from the time of their formation or their initial metamorphism. This environment seems to have been typical of some very old gneiss-granulite complexes, of those forming separate blocks of the Earth's crust within the Kola Peninsula in particular (certain relict datings of rocks from these blocks are given in Table 3).

Isotope methods are usually applied to obtain the time of formation (or transformation) of magmatic and metamorphic rocks. Dating of syntectonic and late-tectonic granitoids and of various metamorphic rocks provides a possibility to determine the time of tectonic-plutonic processes (i.e. the time of diastrophism). Dating of intrusive rocks of platform type or of other kinds of intrusive rocks not related to folding reveals the time of magmatic processes or of thermal activation of stable portions of the Earth's crust. Only rarely is it possible to determine the time of formation of sedimentary piles that originated in the intervals between the orogenic cycles and magma intrusions. It is possible to evaluate their age indirectly by dating volcanics emplaced in the sediments. But in the older complexes these rocks are commonly metamorphosed or altered under the influence of postmagmatic processes and thus the values obtained are not always adequate.

It is only possible to obtain the age of a sedimentary rock or the age of sedimentation directly by dating the unaltered or slightly altered rocks from platform strata and rarely from geosynclinal ones. Even then, however, we are not sure that true age values rejuvenated by later processes. Glauconite, a syngenetic mineral, is commonly used in the K-Ar dating of sedimentary deposits, it easily loses argon at low temperature and thus the values obtained are notably rejuvenated and give only the upper age limit of the wall rocks. It is known that the older the rock is, the greater the loss of argon observed in glauconite and the bigger scattering of the values obtained. Certain satisfactory results on glauconite are known, however, for the Precambrian rocks situated in the uppermost part of the sequence of platform strata. Glauconite dating by Rb-Sr analysis is free from defects either due to the unstable crystalline lattice of the mineral or to different secondary changes in composition. Many difficulties are also faced in interpreting datings obtained by K-Ar and Rb-Sr analyses on micaceous minerals of sediments or on clay shales, phyllites, and other similar specimens, for it is not usually possible to state whether these datings reveal an age of diagenesis (epigenesis) or an age of low-temperature metamorphism of primary or superimposed character. Some errors in age determinations in such cases can also be explained by the presence of clastic minerals in the rock. The age of carbonate rocks can be determined by the Pb-Pb method, but if the rocks are only slightly altered, the interpretation becomes inadequate.

Recently great progress has been made in the equipment of isotope dating and the accuracy of laboratory determinations has become very high and is being refined from year to year. However, we have to admit that deciphering the age values is less advantageous than determination. The difficulties in this sphere are primarily due to various considerable processes of migration of elements and their isotopes. In the older rocks these processes were recurrent and very intensive during orogenic cycles when a general rise of geoisotherms took place, and very extensive transportation of solutions and fluids was also recorded, together with different types of deformations. Incidentally, the isotope datings of such rocks are usually interpreted by geologists as an age of the rock (or geologic complexes,) and certain differences in datings, if they exceed the experimental error, are often regarded as a different age of the rock analyzed; in reality they simply exhibit their different geochemical evolution or different grade of preservation.

Isotope rejuvenation is mostly typical of the oldest polycyclic metamorphic rocks of the Precambrian. It is known that the age of their original metamorphism can be determined only by sophisticated studies using different methods (mostly isochron ones). However, even these methods do not always answer the purpose. Dating of the older gneisses of the Limpopo belt in Southern Africa by Rb-Sr analysis can be given as an example. At first their age was evaluated to be 1900–2000 m.y.; the same age was obtained by K-Ar dating of micas (Van Breemen et al. 1966). Further detailed studies (Van Breemen and Dodson 1972) gave older age values of gneisses (of granite-gneisses to be more exact): 2690 $\pm$ 60 m.y. ($^{87}Sr/^{86}Sr = 0.7038$). Recently (Barton et al. 1977) the same method gave an age of 3856 $\pm$ 116 m.y. ($^{87}Sr/^{86}Sr = 0.7014$) for the granite-gneiss of the Limpopo belt and an age of 3643 $\pm$ 102 m.y. ($^{87}Sr/^{86}Sr = 0.7014$) for the amphibolite dynes in it. Geologic material shows all three stages of metamorphism superimposed on the older rocks and revealed by isotope methods (see Salop 1977b). Many examples of this kind can be given.

Geochronologists usually think that the low primary strontium isotope ratio, typical of the greatest portion of the old rocks, disagrees with the concept of isotope rejuvenation. Many cases can be cited when obviously rejuvenated datings were obtained for the oldest (Katarchean) rocks with low $^{87}Sr/^{86}Sr$ ratio. During metamorphism the loss of a number of elements from rocks is known to occur (of K, Na, Rb, Sr, U, Th, etc.) and, as a rule, the daughter elements (isotopes) of radioactive decay that have less stable bonds in the mineral crystal lattice are being evacuated more intensely. It is possible to suggest that the radiogenic ^{87}Sr will migrate during many thermal-metamorphic processes quicker than the stable ^{86}Sr. If this is so, then the $^{87}Sr/^{86}Sr$ in the recurrently metamorphosed rock will not notably increase. Besides, during a long process (and the duration of thermal processes in the Early Precambrian was several million years), an intensive loss of Rb is to be registered that will also result in a decrease of radiogenic strontium in rocks. The most intense fractionation of isotopes propably happened during the ultrametamorphic processes typical of the Early Precambrian. It was shown (Heier 1964) that during ultrametamorphism the anatectic melts are enriched in radiogenic strontium and the residual rocks (gneisses) are being depleted in it and are thus characterized by a low $^{87}Sr/^{86}Sr$ ratio. Thus, it is not always possible to use the strontium isotope ratio for elucidating the pre-history of highly altered polymetamorphic rocks [1].

The "rejuvenation" phenomena of the older rocks can often be registered by coincidence or similarity of their isotope dating and the dating of rocks from a younger metamorphic complex unconformably overlying these former. For instance, the age values obtained by different methods for the rocks of the oldest gneiss (gneiss-granulite) complexes are commonly close to the values determined for the rocks from the greenstone strata resting on gneisses with a significant angular unconformity. In these cases the datings of both types of rocks fall within the 2600 to 2800 m.y. range; the same age is recorded for granitoids underlying the greenstone strata and cutting them. It is evidently suggestive of the older complex being rejuvenated by the late metamorphism. It will be shown below that the Precambrian orogenies (especially during the Early Precambrian) were separated by very long (several hundreds of millions of years) time intervals. It is known that some rare "relict" datings of the rocks of the gneiss-granulite complexes give values of the order of 3500–4000 m.y. This example and many more demonstrate that while interpreting the isotope datings it is necessary to take into consideration not only their analytical (geochemical) aspects but also geologic observation data as an obligátory element of it.

Still, in spite of many difficulties met in deciphering data of isotope analyses, the correctly interpreted radiometric ages are very important and constitute an objective base for correlation of Precambrian formations even in distant regions.

3. Geohistorical Methods

Geologic methods of division and correlation of rocks are many and various. To break up the older strata it is very important to establish and follow the angular and stratigraphic unconformities and to know the relations of bedded rocks and plutonic formations which serve the geologic and geochronologic markers denoting diastrophic events that separate the periods of sedimentation and volcanism. Correlation of the rocks distributed in the areas of relatively monotonous geologic structure that is within definite structural-formational zones or sedimentation basins can be achieved by comparing the strata by their lithology and by following their facial changes. This method, however, seems to be unsatisfactory for interregional correlation and especially in the case of very distant areas, for instance for the areas situated in different

1 The same can be stated about the application of strontium isotopes in studying the genesis of magmatic rocks; naturally, the high value of this ratio always points to the lithogenic (crustal) origin of magma but the low ratios are difficult to interpret without knowledge of the sample evolution.
Migration of radiogenic strontium is also likely to occur under the low-temperature processes. Thus, the loss of the ^{87}Sr isotope is reported under the effect of hydrothermal (metamorphic) solutions in the Tertiary basalts of zeolite facies in Iceland (Wood et al. 1976)

continents. Then the geohistorical (including the formational) methods become of exceptional importance. Many empiric generalizations are the basis of these methods; it is believed that certain irreversible changes in the tectonic evolution of the Earth exist, and that they are also known in the chemical composition and thermodynamic conditions of its outer shells which, when combined, govern the evolution of sedimentation and rock formation. The origin of specific, unique types of rocks and their associations (paragenesis, formations) is a result of this evolution and they build up definite levels in the normal Precambrian sequence and thus can be used for the global correlation.

In the first case these are the sedimentary rocks, as their origin greatly depends on the evolution of atmosphere and hydrosphere composition, and on the concentration of free oxygen and carbon dioxide in particular. These are various ferruginous, manganese formations, gold-uranium bearing conglomerates, red beds, carbonate rocks etc. Certain levels in the Precambrian are also characterized by supracrustal formations with some geochemical peculiarities, for instance, higher concentration of iron, manganese, copper, phosphorus, barium, uranium, gold, and some other elements that in some localities attain economic importance. Then the formations uprising under definite tectonic and climatic environment typical of certain stages in the Precambrian should be mentioned; these are, for example, crusts of weathering or different orogenic formations. Some peculiar magmatic formations should also be examined among the geogenerations under discussion, for instance, the komatiite, subaerial rhyolitic, or trachyte-rhyolitic lava; they are reported from strata of different age but they are mostly constant and characteristic in the Precambrian complexes of a definite stratigraphic level. Some specific intrusive formations also belong here, as they accompany some Precambrian orogenies, for example the rapakivi granites and anorthosites of different types. It seems reasonable to mention also the sediments originating from the activity of organisms and containing different organic remains.

The glacial formations are of exceptionally great significance for division and global correlation of the older strata, which were formed due to an abrupt fall of temperature registered in several periods during the geologic history when the typical hot Precambrian climate for a short period became cooler. Glaciations on the Earth were principally initiated by cosmic agents and in the Precambrian they embraced the entire surface of the planet irrespective of latitude (Salop 1973a, b, 1977c). The climate-stratigraphic criterion thus becomes of great significance for Precambrian stratigraphy if this special characteristic of glaciations in the far past is considered.

It is important also that some empirical regularities on the vertical distribution of specific formations and rock types, when repeatedly confirmed by isotope age determinations, acquire a separate and objective significance for the division and correlation of older strata. It is well known that if the "irreversible" formations are applied for correlation of Precambrian together with isotope method control the results obtained are very significant and revealing. On this basis it became possible to make a detailed subdivision of Precambrian into several lithostratigraphic complexes followed in different continents. Naturally, the formational (lithoparagenetical) method is much more important in Precambrian stratigraphy than in Phanerozoic. It was stated by the author in previous works and will be demonstrated here that certain characteristic aspects of early geologic evolution are responsible for this.