COMPARISON OF MAJOR SEDIMENTARY FACIES AND AGES OF GRANITIC ROCKS IN THE JAPANESE ISLANDS TO THOSE OF THE ADJACENT PARTS OF THE CONTINENTAL MAINLAND

by

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(with 2 Text-figures)

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Cambrian and Ordovician strata are unknown in Japan and the known oldest fossiliferous rocks are of Middle Silurian age. Conversely, in north Korea and south Manchuria, Cambrian strata extensively overlies Precambrian rocks with marked unconformity; these in turn are covered by Ordovician formations. Both the Cambrian and Ordovician strata are marine in origin, comparatively thick, and mainly composed of sandstones, shales and limestones in which volcanic materials are almost lacking. These rocks may be considered as parageosynclinal deposits.

Marine Silurian, Devonian and Lower Carboniferous deposits are almost entirely absent in these parts of the Asian continent as well as in vast regions in north China, where Cambrian and Ordovician formations are also well developed. However, along the Mongolian geosyncline, which extends from the Great Khingan to the region between the Soviet Union, north Korea and N. E. China, Silurian and Devonian marine deposits are fairly well developed.

With respect to the Devonian of both the continent and the Japanese islands, certain similarities are noted in sedimentary facies, especially as regards the predominance of non-calcareous rocks with abundant volcanic products.

Fossiliferous Tournaisian strata have been not found as yet in the adjacent parts of the continent, although they may be present. In contrast, marine deposits of Tournaisian age which indicate eugeosynclinal conditions are widely distributed in Japan. The existence of *Sugiyamaella*, a somewhat unusual fossil coral, in Japan and in N. W. China may indicate a late Tournaisian age; also, the blastoid *Nymphaeoblastus anossofi* YAKOVLEV occurs in both Japan and in Russia and is indicative of the late Tournaisian, as well as many other fossils of this age in Japan.

Upper Viséan formations are known both in Japan and in the Mongolian geosyncline of the continent and are largely represented by carbonate rocks containing

small amounts of volcanic products.

In Japan, the Pennsylvanian is almost exclusively represented by marine deposits similar to older marine carbonates, while on the continent, especially outside of the Mongolian geosynclinal basins, terrestrial deposits commonly occur in this s stem, as well as coal seams and well-developed aluminous shales.

Marine facies also predominate throughout the entire Permian of Japan, although marginal facies containing land plants are locally present in the Lower Permian, especially in the basal part of the *Pseudoschwagerina* and *Pseudofusulina* zones. On the mainland, conversely, in areas outside of the Mongolian geosyncline terrestrial facies widely replace marine sediments.

Moreover, the Japanese Permian is characterized by its richness in volcanic products in several regions at certain horizons, while volcanics are almost entirely absent on the continent except in the Mongolian geosyncline.

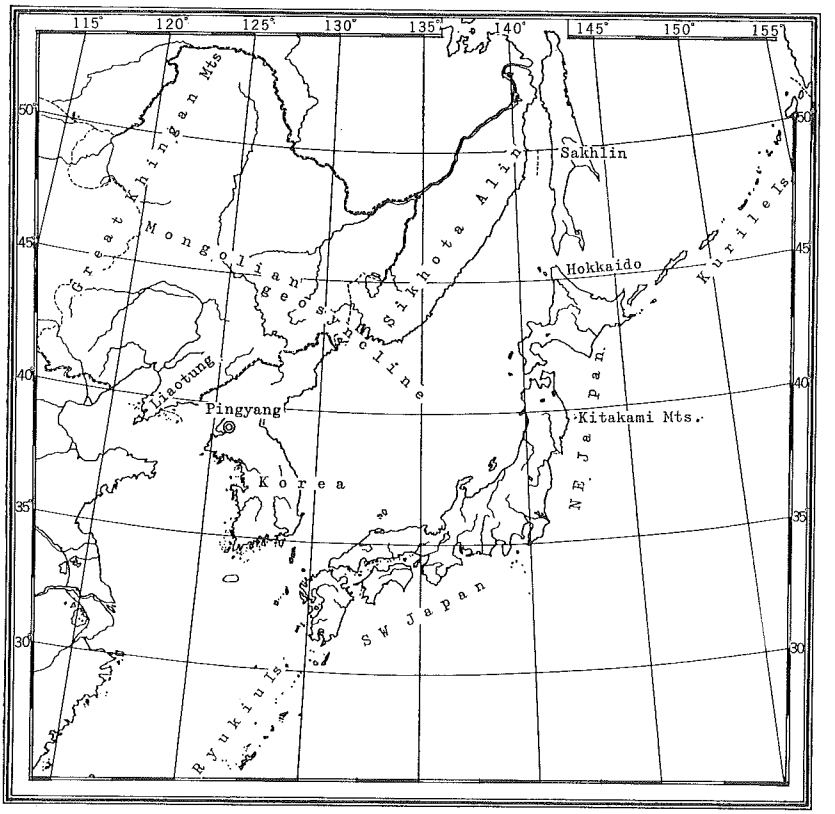

Fig. 1
Japanese islands and nearly adjacent areas in the continental mainland.

Thus the absence of marine Cambrian and Ordovician strata in Japan seems to indicate that during this interval the Japanese islands may have been a rather stable landmass, while at the same time the adjacent parts of the continental mainland were sinking and receiving marine deposits.

The Japanese Paleozoic, from the middle Silurian to the end of the Permian, is represented almost exclusively by marine deposits, although these consist of various types of deposits including local marginal sediments. Of course, stratigraphic hiatus that resulted from regional or local upliftings which occur at various horizons in the Paleozoics of Japan make it impossible to entirely preclude the possibility that terrestrial deposits were once present in the Japanese islands. Insofar as Paleozoic deposits that are now observable in Japan, are concerned, however, this interval of time is almost entirely represented by marine deposits.

Additionally, in Japan, volcanic products are common in nearly all Paleozoic formations except those of Silurian, Upper Viséan and Uppermost Permian ages. Although these are varied in type and abundance from region to region, when compared to the Paleozoics of the continent, except for the Mongolian geosynclinal region, volcanic activities seem clearly to have been much stronger in Japan throughout the Paleozoic than on the mainland.

In North Korea, South Manchuria and in the extensive regions of North China, (again excepting the Mongolian geosyncline) terrestrial sediments seem to have predominated over marine deposits, especially in the Pennsylvanian and Permian, which also is in marked contrast to stratigraphically equivalent formations in Japan.

It is also of interest to consider observable differences between the Mesozoic formations of the Asian continent and the Japanese islands. Following Permian time, seas generally withdrew from the mainland, including the basins of the Mongolian geosyncline; Mesozoic formations thus are almost exclusively terrestrial. However, marine transgression repeatedly occured in Japan. The Mesozoic of Japan primarily consists of marine sediments, although marginal or terrestrial rocks occur at many horizons as rather thin and episodic deposits.

Moreover, volcanic products are rather common at many Mesozoic horizons on the mainland, ranging in age from the Upper Triassic to the Late Cretaceous. Conversely, volcanic activity was much diminished during the Mesozoic in Japan, especially as compared to the Paleozoic. Volcanic materials locally occur in Triassic formations in southern Japan and in the Upper Jurassic of northern Japan; also, volcanics are comparatively common at some horizons in the Cretaceous. However, these are not at all comparable in volume to those found in the Mesozoic of continental mainland. Volcanic activities accordingly can be concluded to have largely shifted from Japan to the continent during Mesozoic time.

The Paleogene of the Asian continent, especially that of Korea, N. E. and N. China also is represented only by terrestrial sediments, including lacustrine de-

posits, while in Japan the Paleogene is approximately equally divided between terrestrial and marine deposits. In both regions, volcanic activity was slight or entirely lacking. However, in the northern Japan and Saghalin, volcanic products increase upward in amount throughout the Paleogene and are especially prominent along the continental coastal region called Sikhota-alin. The Paleogene deposits of these northern regions are both marine and terrestrial in origin.

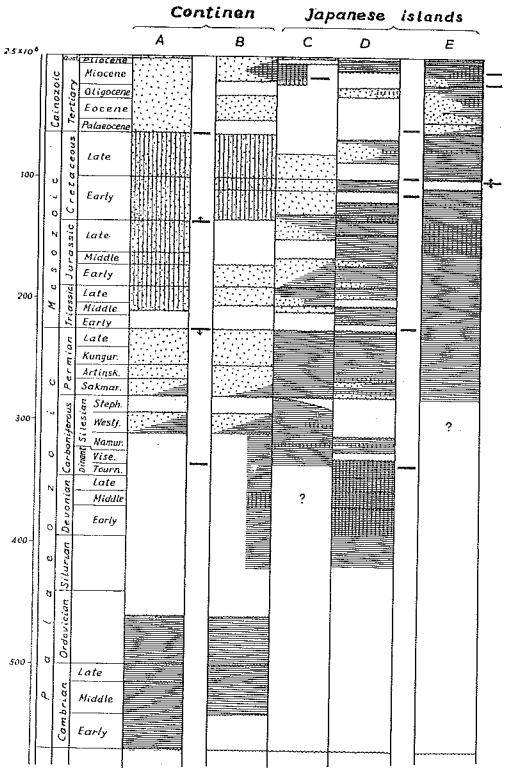

Fig. 2

Comparison of major sedimentary facies and ages of granitic rocks in Japan to those of the adjacent parts of the continental mainland. Stippled pattern indicates terrestrial facies; horizontal lines, marine facies; vertical lines, predominately volcanic facies; open areas (no pattern) indicate the approximate duration of stratigraphic hiatuses. Thick horizontal black lines in margins indicate the approximate periods of granitic intrusions; accompanying arrows indicate the possibility of slightly younger or older ages for these granites where reasonable doubt exists.

A: Liaotung pennisula, southern Manchuria, China, Pingyang area in north Korea, and northern China.

B: Mongolian geosynclinal basins.

C: Inner belt of southwest Japan.

D: Outer belt of northeast Japan, including Kitakami Mountains.

E: Outermost belt of northern Japan, including Hokkaido.

The Neogene of the continental mainland is also entirely terrestrial except for the area surrounding the Japan Sea. Neogene formations developed in the continental interior almost entirely lack volcanic products.

In the Japanese islands, marginal deposits are common in the Neogene, but most of the Neogene is marine in origin.

Volcanic activity was almost continuous in Neogene basins, especially in the inner belt along the Kurile, Honshu, Izu-Mariana and Ryukyu islands arcs.

Thus at this stage volcanic activity can be concluded to thave again shifted, from the continent to the island arcs.

Finally, the ages of intrusion of granitic rocks must be briefly discussed. In Japan, almost all granites exposed at the surface are of Early or Late Cretaceous age. However, Paleozoic granites occur in Japan and are assumed to be of Lower Carboniferous age, possibly Pre-Upper Viséan. These older granites are discontinuously distributed along rather limited and along narrow metamorphic belts, but there is compelling evidence that still older granits that may have formed a basement complex in the Japanese islands was present but was reactivated by plutonism of Carboniferous age.

All those plutonic bodies mentioned above apparently occupied the axial core of the older geosyncline of the Pre-Upper Viséan age, and also may have been present at basins where not only Paleozoic but also Mesozoic deposits subsequently accumulated in great thickness in Japan.

The gross ages of granitic intrusions in Japan and in the continent adjacent to Japan are similar: Late Palaeozoic, Neocomian, and Senonian. Further, continental granitic intrusions apparently occured at depth in the geosynclinal basins along the Mongolian geosyncline as well as in Mesozoic basins where thick terrestial deposits and large amounts of volcanic products accumulated. In the last instance, the Mesozoic basins of the continent are concluded to have shifted towards the north or east from the older geosynclinal basins of the Paleozoic. Similarly, the distribution of Cretaceous granites seem to have migrated from that of Late Paleozoic granites.

The existence of Intra-Triassic granites is the subject of divergent opinions in Japan and on the continent. Further study will be required to settle the disputed age of these rocks.

So-called " Miocene " granites in Japan are exposed only along very narrow belts and in general occur only as small stocks. Nevertheless, these bodies show holocrytalline texture and commonly are dioritic. These younger granites generally are found in the inner belt of islands arcs where thick marine Neogene deposits are accompanied by a large amounts of volcanic products and along the outer belt of SW-Japan where thick Paleogene and Neogene deposits of " Flysh " facies occur. In the last-named regions, the " Miocene " granites appear as compartively large masses compared to those of the inner belts of the island arcs.

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