SIGNIFICANCE OF CONGLOMERATES IN INTERPRETING THE MESOZOIC HISTORY OF THE NORTHERN ROCKY MOUNTAINS.

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Foreword.

During field work on the western Great Plains and in the adjacent front ranges of the Rocky Mountains in Montana and northwestern Wyoming prominent conglomerates were observed in certain Mesozoic formations. As these conglomerates obviously afford considerable significant data for interpreting the contemporaneous geography and physiography of that portion of the Rocky Mountains in which they occur, as well as of portions of the source province, a study of the literature was begun in order to outline the problem of their distribution and origin.

Conglomerates have been observed by many geologists in this region, but the nature of most of the field investigations did not permit particular attention being given to them. As a result they are generally briefly described without interpretations; in some cases they are only mentioned as part of the general section. However, all reports that contain much stratigraphic data on the Mesozoic formations at least mention them. A few workers in other parts of the Rocky Mountains, especially Mansfield in southeastern Idaho, have recently suggested or made interpretations of some of the Mesozoic conglomerates.

This article is a brief preliminary summary of some of the data with partial interpretation of them. It is not an exhaustive treatment, as much study of the literature and considerable field work will be necessary to treat the subject in a comprehensive manner. The purpose of this paper is to emphasize the value of most conglomerates in deciphering the paleophysiography of extensive regions, to stress the need of more thorough field study and more complete description of significant conglomerates, and to summarize some of the numerous facts about Mesozoic conglomerates that are scattered through the extensive literature of the northern Rocky Mountains. Although equally significant conglomerates are present elsewhere in the Cordilleran region they are not considered at this time. More complete discussion will be given in a subsequent paper.

Distribution and Range.

Conglomerates are somewhat numerous and widespread in the Mesozoic formations of the Rocky Mountains and even in the larger Cordilleran region. Some are local but a few are remarkably persistent. They are present along the western Great Plains and in the ranges of the Rocky Mountains in Montana and Wyoming wherever extensive Mesozoic sections exist. Some have been reported as far north as northwestern Canada and others as far southwest as the Plateau region of Utah and Arizona. Their east and west limits are not definitely known, but the conglomerates seem to be more common in the eastern part of the northern Rocky Mountains and on the adjacent plains. In places they occur as far west as do the Mesozoic formations, and no doubt once extended much farther west. This vast area is not covered by one or more continuous sheets of conglomerate; with, perhaps, one notable exception, the conglomeratic zones are markedly discontinuous.

The principal conglomerate horizon in the northern Rocky Mountains is the lower part of the Lower Cretaceous (Comanchean), mainly the Kootenai formation or its approximate equivalents. This conglomerate has attracted most attention because of its persistence and thickness, and it has been interpreted by a few geologists. Conglomerates are present in other Mesozoic formations, chiefly in the Ellis formation (upper Jurassic) and in members of the Colorado and Montana groups (upper Cretaceous). The overlying Lance and Fort Union formations also contain conglomerates which seem to antedate the main Laramide orogeny that caused much coarse detritus to be supplied to post-Fort Union basins.

The Pennsylvanian and Permian of Western Montana and adjacent states contain some conglomerates that are somewhat similar to those in the Mesozoic formations. Conglomerates of this age extend as far west as the east side of the Sierra Nevada. These older strata will not be discussed at this time.

Triassic conglomerates are very widespread and persistent in the Plateau region of the Southwest. They have been treated in some detail by numerous workers in that province.

Character and Relations.

Much of the coarse material in the Mesozoic conglomerates is chert. It is mainly in the form of small black pebbles, but other colors are rarely present. Pebbles of quartzite and limestone are moderately abundant in places, and pebbles of sandstone and shale are reported from a few localities. Igneous pebbles occur locally in some formations, chiefly in the Fort Union. Black chert pebbles form prominent beds at some horizons in the Cretaceous of central Montana and northwestern Wyoming. As the formations weather these pebbles are strewn in considerable abundance along gentle dip slopes.

Most of the chert and quartzite pebbles are subangular to rounded. Highly angular fragments seem to be scarce except at a few localities in Wyoming and in parts of Idaho. The black chert pebbles in the Cretaceous of Montana generally have smooth, somewhat polished surfaces. Hence, much of this material is travel-worn.

The pebbles are as a rule less than one inch in diameter. Some beds are without pebbles larger than one-half inch. Some chert cobbles rarely as large as one foot have been reported. Insufficient data are at hand to state definitely the distribution of size grades, but it appears that the size increases rapidly westward from the plains and front ranges.

The thickness of the conglomerate zones is variable. In many places the beds are lenticular, varying from several inches to several feet in maxium thickness. The Kootenai conglomerate is persistently a few tens of feet in thickness, and in places becomes almost 100 feet thick. Mansfield[1] reports two conglomerates in the Lower Cretaceous (?) of southeastern Idaho to be each about 1,000 feet thick.

In addition to the well-defined conglomerate zones some of the typical standstones are highly arkosic. Many of the Cretaceous sandstones are conspicuously peppered with small grains of black chert.

Some of the conglomerates or conglomeratic standstones which are remarkably persistent are almost certainly basal conglomerates. Many of the other zones may be found to represent a decided break in sedimentation. Some of the conglomerates are intraformational and probably indicate nothing more than temporary changes in the conditions of sedimentation.

[1] Mansfield, G. R., Geography, geology, and mineral resources of part of southeastern Idaho: U. S. Geol. Survey Prof. Paper 152, pp. 103-104, 1927.

General Interpretations.

These Mesozoic conglomerates and conglomeratic sandstones suggest several things about the late Plaeozoic and Mesozoic physiography and conditions of sendimentation in the northern Rocky Mountains. The chert pebbles and grains are particularly significant because they best survived the stress of erosion in the source area and of transportation to the final site of deposition. Furthermore, they can in many cases be more confidently traced to parent formations.

The source of most of the chert is Paleozoic limestones. Scattered nodules and discontinuous seams of chert are common in some of the Carboniferous limestones, and nodules are present in Devonian and Ordovician limestones. Unfortunately, too little study has been made of these limestones and especially their cherts to trace the pebbles to their sources in as much detail sa may be done in the future. Fossils have been discovered in the cherts in a few sections, but such occurrences are rare.

The quartzite pebbles appear to have been derived mainly from Proterozoic formations, such as the Beltian series in Montana, but some may have come from Paleozoic strata. Igneous pebbles and feldspathic grains may have been supplied by rocks of widely variable age, but the pebbles in the Cretaceous conglomerates, including the Fort Union horizons, probably came mostly from pre-Cambrian terranes. Some of the granitoid pebbles are in places certainly of this origin. The limestone, sandstone, and other pebbles are more or less local, having been derived from Paleozoic and early Mesozoic formations that were exposed near the sites of sedimentation.

The abundance of chert pebbles and grains in conglomerates and standstones and the wide distribution of these sediments indicate a total mass that is very large. Since chert constitutes only a small per cent of any source formation the conclusion is warranted that great decay and disintegration of Paleozoic limestones occurred during Mesozoic time. Hence, these limestone must have formerly extended far west of their present outcrops.

This extensive and deep erosion indicates that the land mass west of the Mesozoic Rocky Mountain geosyncline was elevated considerably during the Mesozoic era. As a result the Paleozoic limestones were removed probably from large areas. The extent of the uplift, the height of the land mass, and the relative rate of elevation are interesting problems, but more data are necessary before even useful suggestions can be made. A detailed study of the chert conglomerates would probably afford much information in regard to the paleotopography of the region and the conditions of piedmont and flood-plain sedimentation during the Mesozoic.

The general uplift of the region west of the main basin of early Cretaceous sedimentation has been recognized by some students, but its importance has commonly not been sufficiently stressed. Schuchert has recently shown the general conditions on paleophysiographic maps.[1] Mansfield has given an excellent interpretation of Cretaceous conglomerates in southeastern Idaho. The significance of other conglomerates, especially those of more restricted distribution and of older age, and has not been so well recognized. Much work remains to be done before their paleogeographic bearings are fully deciphered. The several conglomeratic horizons and the repeated recurrence of chert pebbles and sand grains may signify cyclic conditions, either of a diastrophic or climatic character, in the source region.

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[1] Historical Geology, 2nd edition, p. 511, 1924.