TRANSPORT PRESSURE MARK MECHANISMS IN LATE CRETACEOUS-EARLY EOCENE CONGLOMERATES, NORTHWESTERN WYOMING

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Objectives

In spite of rather intensive investigation into the origin of the Harebell (Late Cretaceous), Pinyon (Paleocene) and Pass Peak (Early Eocene) conglomerates in Jackson Hole and adjacent areas certain critical questions remain unanswered. The great thickness, coarseness and lateral extent imply an ancient source of considerable size and relief relatively near to present day Jackson Hole. Evidence for such a source is, however, equivocal and previous workers do not agree on its location. An even more perplexing question concerns the mechanisms by which such a huge volume of cobbles and boulders was transported from the source, wherever it was, to its depositional site. Such a system implies the existence of ancient alluvial fans on a scale unknown in modern environments.

Subsequent to deposition the clasts in all three of these units were pressure marked; that is, there was minor pressure solution, incipient fracturing and interpenetration at almost all clast contact points. The exact causal mechanism of pressure marking is, however, not known. The question as to whether it can be attributed to simple lithostatic load or whether seismic shock is required deserves particular attention. Furthermore, the exact timing of pressure marking is of particular importance in reconstructing the Laramie tectonic history of the region. There is some evidence that the youngest of these deposits was derived by reworking the older units but the older units could not have supplied the observed well-rounded clasts if pressure marking and fracturing had already occurred.

Several important studies have been conducted on these units, but because of their particular orientation they have not answered these questions. Antweiler and Love (1967) documented the gold content of these and other deposits and this work was updated by Antweiler and others (1977). Steidtmann (1969, 1971) determined the general stratigraphy, source and depositional environment of the Pass Peak Formation and later described the Laramide tectonic history of the region with his co-workers (Dorr, Spearing and Steidtmann, 1977a, 1977b). Both Love (1973) and Lindsey (1972) studied the stratigraphy and sedimentary petrology of the Harebell and Pinyon formations but came to drastically opposing views as to sediment source and tectonic significance. The tectonic implications had already been outlined in Love and Reed (1968).

This study is of a preliminary nature. Its objectives were to conduct observational field work on these conglomeratic units to determine if sufficient field evidence is present to warrant a full scale study on the hydrodynamic conditions present during transport and deposition and to collect material which will be used to test several methods of determining the timing and mechanism of pressure marking.

Procedures

The problem of transport mechanism was approached by comparing field observations of hydrodynamically significant sedimentary structures and textures such as scour and fill features, cross-stratification, clast imbrication, clast size and matrix proportion and size with published experimental and observational information where hydrodynamic conditions are known.

The approach to the pressure marking problem was somewhat less straightforward because so little is known and there has never been a systematic investigation of the phenomenon. Therefore basic field relations such as stratigraphic and areal distribution of pressure marking were observed. Samples of pressure marks and deformed matrix were gathered to see if laboratory techniques, such as paleomagnetic orientation, could be used to establish the time of marking.

Results

Field observations on sedimentary structures and textures generally concur with those made by previous investigators. Clast imbrication is present but poorly developed in most exposures, primarily because clast sphericity prohibits well-developed preferred orientation. Very large-scale cross-stratification is present in most of the interbedded sandstone units and some of the conglomeratic units as well. In both cases it appears to be the result of oblique filling of scours or the downstream migration of large channel bars. Very little cross-stratification is related to the migration of small, hydrodynamically indicative bed forms. This particular condition probably exists because the scale and energy of transport was far greater than that observed in similar present day environments, and certainly far greater than the experimental conditions for which hydrodynamic relations are known.

Reconnaissance sampling provided several samples from which matrix and clast-size relations were determined. A comparison of these two size distributions indicates that the energy of transport, which was capable of rolling the observed clasts, was also capable of transporting much larger sand-size material in suspension than was actually observed. The implications of this relationship are not entirely clear at this point but it is suggested that there may have been important source area controls on the size and amount of sandy material supplied to the sediment transport system.

Attempts to find pressure mark related material for paleomagnetic dating proved fruitless. It was hoped that cementation rims and deformed fine-grained matrix material, both related to the pressures which caused pressure marking, could be found in the size and abundance necessary for paleomagnetic dating. This may have provided a way to determine whether the pressure marking is the same age throughout the conglomerate or whether it took place at different times. Unfortunately none of the pressure mark rims are large enough to run paleomagnetic determinations and related deformed fine-grained sediments are quite rare.

Conclusions

The results of this preliminary study indicate it is unlikely that sufficient information is available to make a more refined interpretation of the hydrodynamics of transport and deposition than is already available in previous investigations. This conclusion stems not only from the general paucity of the necessary types of sedimentary structures also from the lack of comparative information from modern, high-energy environments. The modern Kosi River Delta of India is probably a relatively close modern counterpart to the depositional environment of these coarse clastics but very little has been published which can be used for comparative purposes. In addition, paleomagnetic dating of pressure marks does not appear to offer much in the way of dating the time of marking in different areas and stratigraphic levels. If this problem is to be solved, other techiques will have to be devised.

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