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Origin of limestone conglomerates in the Choson Supergroup (Cambro-Ordovician), mid-east Korea

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Abstract

The Choson Supergroup (Cambro-Ordovician), mid-east Korea consists mainly of shallow marine carbonates and contains a variety of limestone conglomerates. These conglomerates largely comprise oligomictic, rounded lime-mudstone clasts of various size and shape (equant, oval, discoidal, tabular, and irregular) and dolomitic shale matrices. Most clasts are characterized by jigsaw-fit (mosaic), disorganized, or edgewise fabric and autoclastic lithology. Each conglomerate layer is commonly interbedded with limestone-dolomitic shale couplets and occasionally underlain by fractured limestone layer, capped by calcareous shale.

According to composition, characteristic sedimentary structures, and fabric, limestone conglomerates in the Hwajol, Tumugol, Makkol, and Mungok formations of Choson Supergroup can be classified into 4 types: (1) disorganized polymictic conglomerate (Cd), (2) horizontally stratified polymictic conglomerate (Cs), (3) mosaic conglomerate (Cm), and (4) disorganized/edgewise oligomictic conglomerate (Cd/e). These conglomerates are either depositional (Cd and Cs) or diagenetic (Cm and Cd/e) in origin. Depositional conglomerates are interpreted as storm deposits, tidal channel fills, or transgressive lag deposits. On the other hand, diagenetic conglomerates are not deposited by normal sedimentary processes, but formed by post-depositional diagenetic processes.

Diagenetic conglomerates in the Choson Supergroup are characterized by autoclastic and oligomictic lithology of lime-mudstone clasts, jigsaw-fit (mosaic) fabric, edgewise fabric, and a gradual transition from the underlying bed (Table 1). Autoclastic and oligomictic lithologies may be indicative of subsurface brecciation (fragmentation). Consolidation of lime-mudstone clasts pre-requisite for brecciation may result from dissolution and reprecipitation of $CaCO3$ by degradation of organic matter during burial. Jigsaw-fit fabric has been considered as evidence for in situ fragmentation. The edgewise fabric is most likely formed by expulsion of pore fluid during compaction.

The lower boundary of intraformational conglomerates of depositional origin is commonly sharp and erosional. In contrast, diagenetic conglomerate layers mostly show a gradual transition from the underlying unit, which is indicative of progressive fragmentation upward (Fig. 1). The underlying fractured limestone layer also shows evidence for in situ fragmentation such as jigsaw-fit fabric and the same lithology as the overlying conglomerate layer (Fig. 1).

Table 1. Summary of sedimentary characteristics of the diagenetic and depositional conglomerates in the Choson Supergroup.

	Diagenetic Conglomerate	Depositional Conglomerate
Clast composition	Autoclastic and oligomictic lime-mudstone	Polymictic grainstone and lime-mudstone
Matrix composition	Homogeneous mud	Bioclastic or rarely sandy grains
Clast shape	Spherical, oval, discoidal, tabular, or irregular	Tabular or oval
Fabric	Jigsaw-fit or mosaic fit fabric, floating clasts, edgewise fabric	Flat or horizontal to bedding plane, absence of imbrication
Boundary character	Gradual transition from underlying unit	Sharp erosional base
Bed geometry and lateral continuity	Abrupt lateral facies change, lateral thickness variation	Tabular continuous bed, good continuity
Vertical facies change	Common facies change between underlying and overlying unit	No facies change

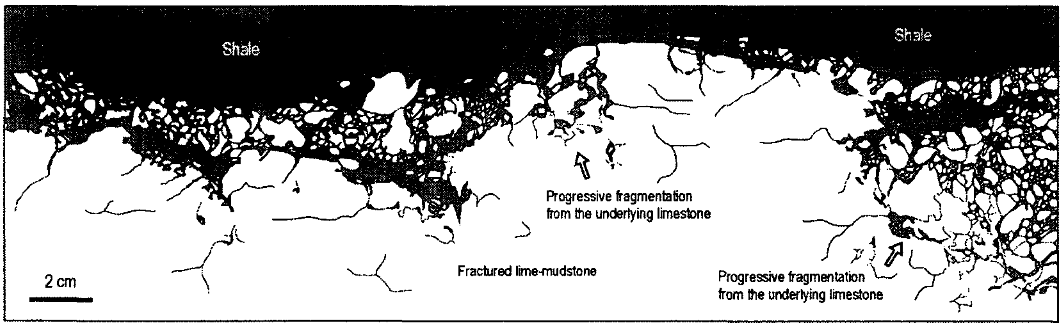

Fig. 1. Sketch of mosaic conglomerate layer (type Cm) (Tongjom section, Tumugol Fm), showing jigsaw-fit fabric, autoclastic and oligomictic lithology of clasts, and gradual transition from the underlying fractured lime-mudstone layer.

Evidence from the conglomerate beds in the Choson Supergroup suggests that diagenetic conglomerates are formed by in situ subsurface fragmentation of limestone layers and rounding of the fragments. In situ subsurface fragmentation may be primarily due to compaction, dewatering (upward-moving pore fluids), and dissolution, accompanying volume reduction. This process commonly occurs under the conditions of (1) alternating layers of carbonate-rich and carbonate-poor sediments and (2) early differential cementation of carbonate-rich layers. Differential cementation commonly takes place between alternating beds of carbonate-rich and clay-rich layers, because high carbonate content promotes cementation, whereas clay inhibits cementation.

After deposition of alternating beds and differential cementation, with progressive burial, upward-moving pore fluid may raise pore-pressure in the upper part of limestone layers, due to commonly overlying impermeable shale layers (or beds). The high pore-pressure may reinforce propagation of fragmentation and cause upward-expulsion of pore fluid which probably produces edgewise fabric of tabular clasts. The fluidized flow then extends laterally, causing reorientation and further rounding of clasts. This process is analogous to that of autobrecciation, which can be analogously termed autoconglomeration. This is a fragmentation and rounding process whereby earlier semiconsolidated portions of limestone are incorporated into still fluid portions. The rounding may be due mainly to immiscibility and surface tension of lime-mud. The progressive rounding of the fragmented clasts probably results from grain attrition by fluidized flow.

A synthetic study of limestone conglomerate beds in the Choson Supergroup suggests that very small percent of the conglomerate layers are of depositional origin, whereas the rest, more than ~ 80%, are of diagenetic origin. The common occurrence of diagenetic conglomerates warrants further study on limestone conglomerates elsewhere in the world.