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Application of heavy minerals as rift-related depositional system criteria in alluvial to fluvial environment: As an example from the Cheju Basin (NE East China Sea) Dragon-1 Well, Korea

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Concepts of rift-related depositional system developed in divergent plate-margin basin setting where sediments preserve a record of the tectonic environment. However, application of these concepts by heavy mineral to alluvial/fluvial basins has been limited. In cases where sandstone modal analysis is not sensitive to tectonic elements, different criteria for rift-related depositional system recognition are necessary.

This paper proposes the utility of heavy mineral concentration and assemblage as criteria for rifting event. Heavy mineral concentration is mainly controlled by the amount of heavy mineral supply from source area and the angle of half-graben slope. Concentration of thick volcanogenic heavy minerals requires process of continuous rifting and volcanic activities which cause heavy mineral supply at a basin-wide scale and can give us idea of rifting time. Concentration in non-volcanogenic heavy mineral, particularly magnetite, can be a function of paleo-slope and/or selective sorting.

Heavy mineral assemblages readily recognized due to distinctive lithologic change are used to distinguish syn-rifting stage from post-rifting stage and to define a tectonic environment. The change in heavy mineral assemblages is a function of the source material and selective sorting imposed during heavy mineral deposition. The identical volcanic material source during rifting stage can be recognized by quantitative heavy mineral analysis for more accurate interpretation.

The heavy mineral concentration and assemblages can play a role as criteria for rift-related depositional system. Heavy mineral analysis in Dragon-1 well represents the tectonic change from syn-rifting stage to post-rifting stage in alluvial/fluvial to lacustrine environment. The syn-rifting depositional system consisting of four sequences is characterized by augite-rich heavy mineral assemblages and high concentration of heavy mineral in lower part, whereas an overlying heavy mineral is characterized by non-volcanogenic assemblages, low concentration of heavy mineral and high concentration of its magnetite. Quantitative analysis

of augite reveal that volcanogenic heavy minerals are derived from the same source during the early syn-rifting stage. The post-rifting depositional system composed of two sequences is distinguished by no volcanogenic heavy mineral assemblages and low concentration of heavy mineral but more rich than underlying sequences.

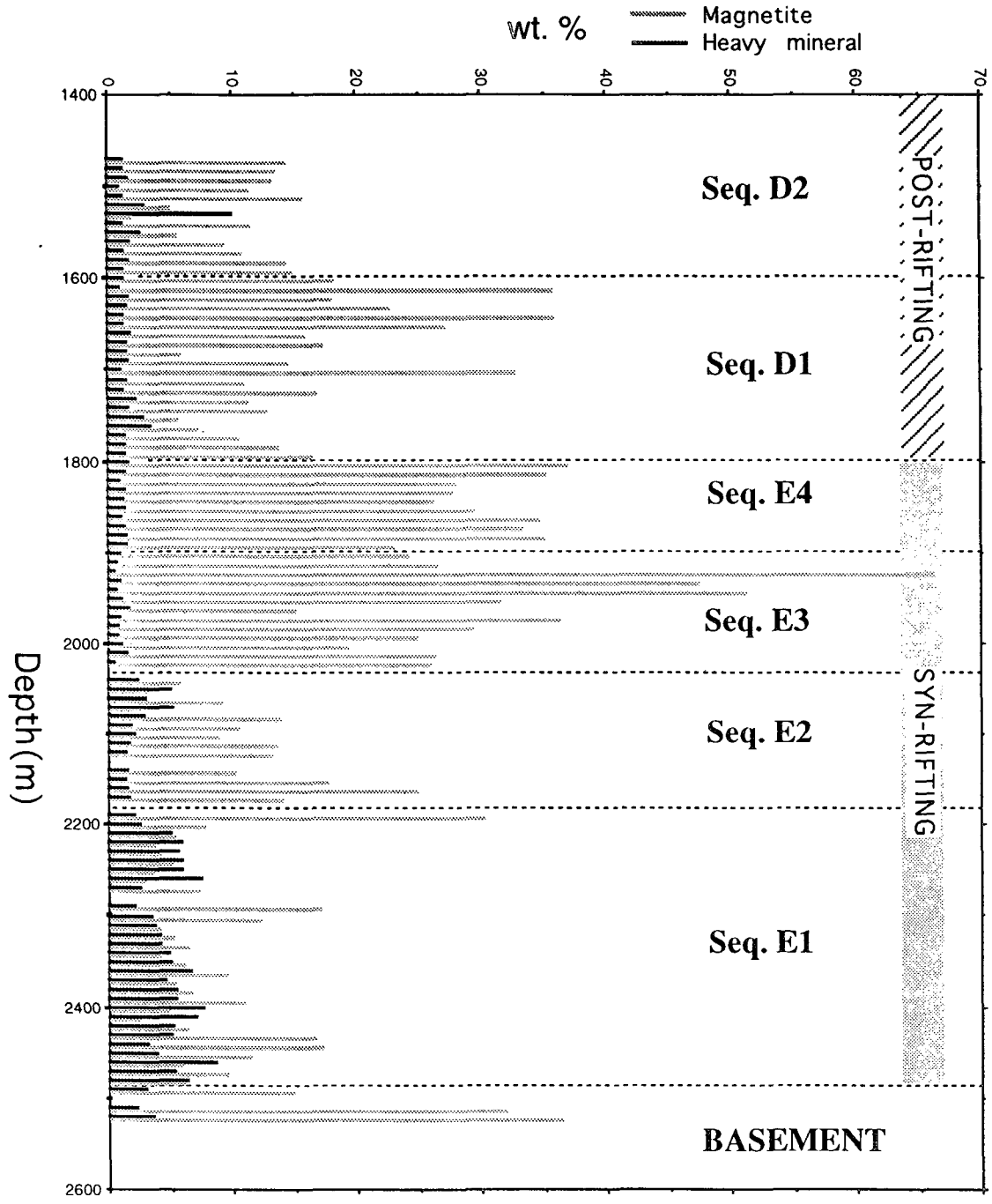

Fig. 1. Summary of heavy mineral concentration during syn-rifting and post-rifting. Sequence boundaries are approximately coinside with the cycles of heavy mineral and its magnetite accumulation.

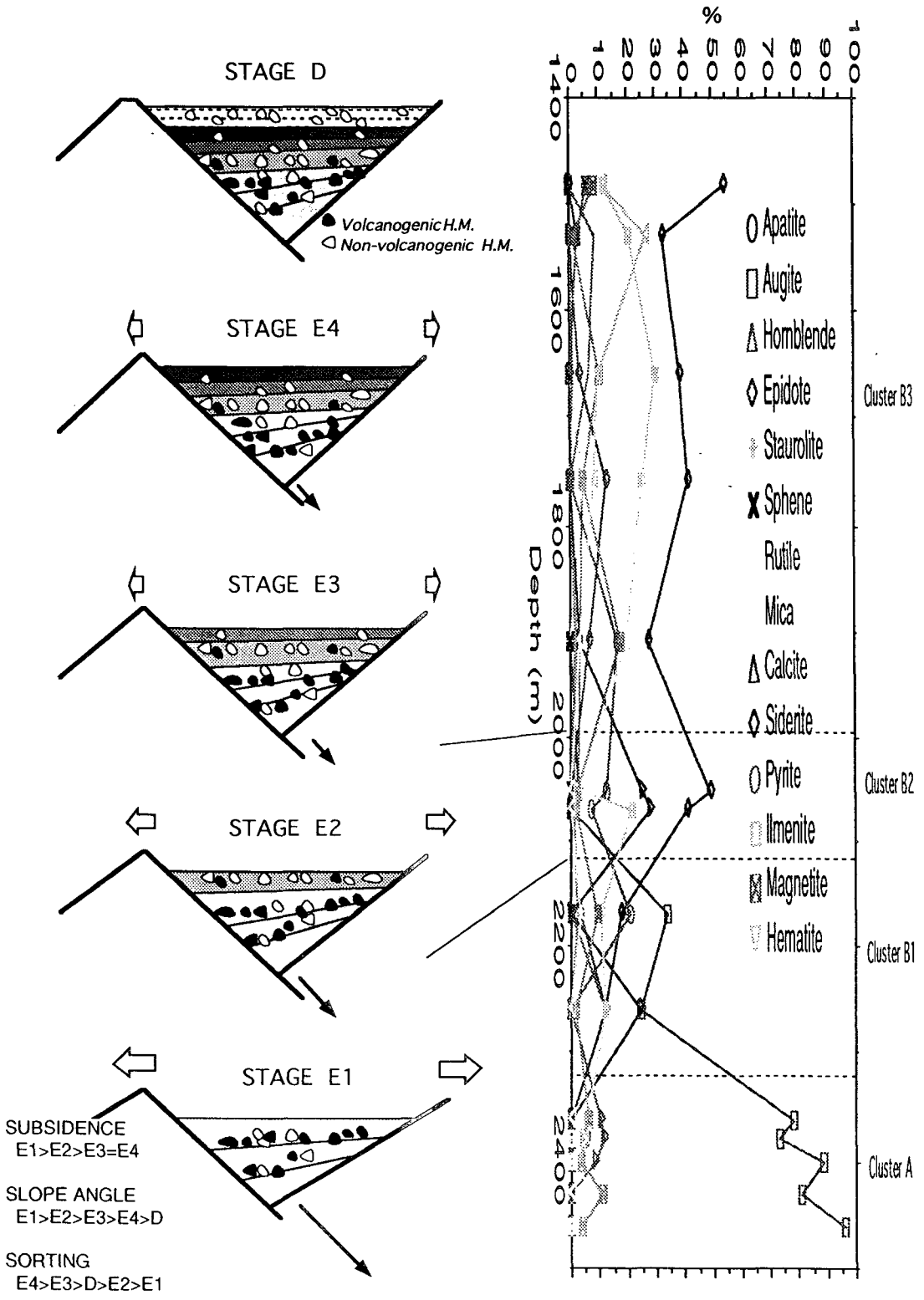

Fig 2. Diagrams to illustrate evolution of rifting stages. Note the heavy mineral variation, illustrating heavy mineral characteristics of each stages. The two principal clusters obtained in Q-mode cluster analysis of heavy mineral compositions.