Stable Isotopes and Element Compositions of Early Createaceous Limestones, Blake Nose: DSDP Site 392

Sang-Hwan Gwak
Korea Institute of Geology, Mining and Materials (shgwak@hanmail.net)

1. INTRODUCTION

In 1975, Hole 392A was drilled 99 m of soft Cretaceous ooze and 251 m of dense and hard limestone at a sea floor depth of 2606.5 m on the Blake Nose, northwest Atlantic Ocean. Shallow marine limestones were directly overlain by upper Barremian to middle Eocene pelagic carbonate oozes. Fourcade and Granier (1989) examined microfossils and concluded that the drowning of the Blake Nose occurred in Valanginian time based on the Portlandian-Early Valanginian age of the shallow marine limestone section.

The shallow marine limestone at Blake Nose consists of three units. Each unit has diagenetic pore-filling equant cements. Almost all samples of the units are nonluminescent under cathodoluminoscope (Enos and Freeman, 1978; 1979). Enos and Freeman (1978, 1979) concluded that the equant cements precipitated in a meteoric phreatic zone, and indicated that the equant cementation probably was completed in the Early Cretaceous prior to subsidence of the Blake Nose into deep water.

The purpose of this work is to determine the origin of the equant cements and the timing of the equant cementation by investigating the diagenetic history of the Early Cretaceous limestones at the Blake Nose.

2. MATERIALS AND METHODS

One hundred nineteen sample slabs of limestone were trimmed from cores of Sites 392. Stable oxygen and carbon isotope compositions were determined using a Delta Finnigan MAT 252 at the University of Georgia. Standard errors are about 0.09‰ for δ 18O and 0.03‰ for δ 13C.

Element composition analysis was done at the Chemical Analysis Laboratory in the University of Georgia using a 965 Thermo-Jarrell Ash Plasma Atomcorps ICP (AES type) for twenty elements. The precision is lower than a part per billion.

Strontium isotope composition was determined using a 9-inch radius thermal ionization mass spectrometer at the University of Georgia. The Laboratory standard was NBS 987, which has a composition of 0.710167 $\pm$ 0.000026. Error is in fifth decimal of the result.

3. RESULTS

Stable isotopic compositions of micrite range from −2.5‰ to +0.8‰ δ18O (all are in PDB) and from +0.4‰ to +2.7‰ δ13C. Compositions of equant cement range from −1.8‰ to +1.2‰ δ18O and from +1.7‰ to +3.6‰ δ13C. Within a 99.9% confidence limit for the t test, the equant cement group has significantly different means of δ18O and δ13C from the micrite group.

Both micrite and equant cement samples are almost pure and low Mg calcites. Mg, Sr, Na, Fe, and Al have higher concentrations in micrite than in equant cement. Zn, Cu, Mn, Cd, Ba, Co, K, Pb, Cr, Ni, Mo, and B have higher concentrations in equant cement than in micrite.

87Sr/86Sr of shallow marine micrite varies from 0.70710 to 0.70742 while 87Sr/86Sr of equant cement varies from 0.70709 to 0.70743 (Fig. 1).

4. DISCUSSION AND CONCLUSION

Stable isotope data and strontium isotope data indicate that equant cements in the Blake Nose precipitated at low temperature in deep marine water in Albian, mid Cretaceous time after subsidence of the Blake Nose. The precipitation temperatures ranged from 13.5℃ to 23.2℃ and mean temperature was 17.3℃ assuming δ18O composition of early Cretaceous tropical shallow marine water was 0‰ relative to SMOW (Muehlenbachs, 1986). Element composition data support that equant cements were precipitated slowly at low temperatures.

Based on the paleontological study of Fourcade and Granier (1989) and δ18O data, the 87Sr/86Sr data indicate that timing of the precipitation of equant cement is Albian in mid Cretaceous. The higher compositions of δ13C in equant cements than in micrites support this timing owe to the secular variation of global δ13C curve in the Cretaceous (Holser et al., 1988).

5. REFERENCES

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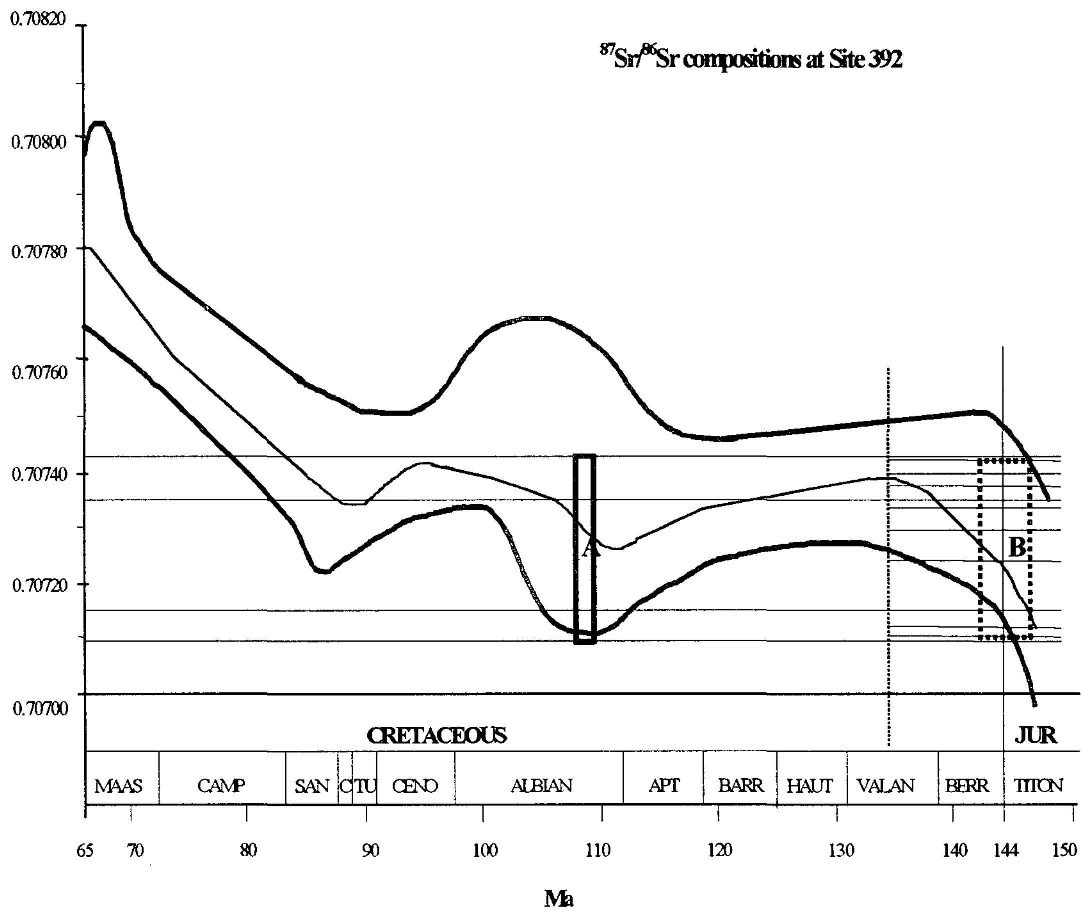

Figure 1. Plot of $^{87}Sr/^{86}Sr$ compositions of 12 samples from Site 392 relative to the envelope of Cretaceous and Jurassic $^{87}Sr/^{86}Sr$ composition (from Koepnick et al., 1985 and 1990). The vertical dashed line indicates the youngest age possible for the micrites at Site 392. 8 horizontal dotted lines are for micrites and 4 horizontal solid lines for equant cements. Area "A" indicates the age estimate for equant cement precipitation and area "B" for micrite precipitation. The Upper and lower thick curves define a band that encloses more than 98% of Cretaceous and Jurassic seawater data points. The thin line drawn through the band is the best estimate of seawater composition.