Appendix 1. Can we use phosphorite intervals as correlation tools and time markers?

The discontinuity of the sedimentary record, the paucity of the fossil record, and the lack of absolute age data complicate the correlation between sections of the study area. Therefore, it may be important to use other correlation tools, in addition of sequence stratigraphic interpretation. In the Doushantuo Formation, two phosphorite intervals appear regionally: one located in the middle part of the formation, the second one on its top. This appendix attempts to show that the phosphorites of the Doushantuo Formation may help to correlate the sedimentary record on the southern margin of the Yangtze platform.

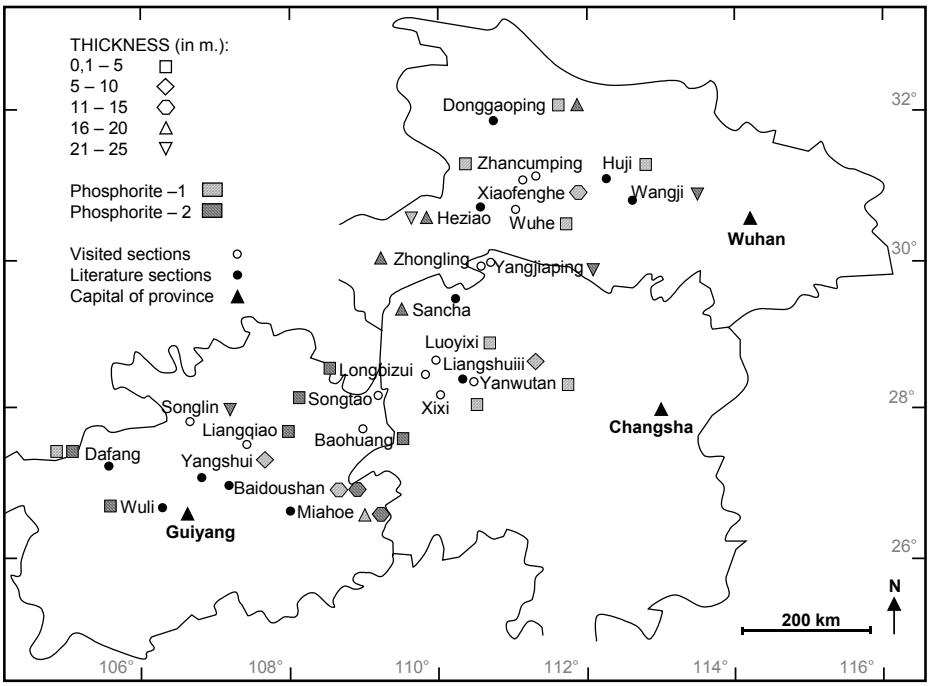

Fig. A. This map shows the location of phosphorite deposits on the southern margin of the Yangtze platform, the thickness of the interval and their relative stratigraphical position.

Can phosphorites be used as correlation tools and time markers?

At present, there is phosphogenesis on the platform margins under upwelling conditions such at the Peruvian and Chilean margins, which is due to high organic matter productivity. However, the upwelling setting does not explain all ancient phosphorite deposits, which provide much more diversity. Trappe (1998) reports phosphorite deposits in partially drowned shelfal platform (Miocene Florida phosphate province), carbonate ramp (Phosphoria rock complex, USA) and gulf with internal topography (marginal basin blanket phosphorite, Central Morocco). Cook et al. (1990) report phosphogenesis in shallow-water carbonate platform (stromatolitic phosphorites of Rajasthan). Then, phosphogenesis is merely the expression of semi-anoxic and high primary productivity conditions provided not only by upwelling-influenced environments.

The map compiled from regional Bureau of Geology and Mineral Resources (1987, 1988, 1990) and own data (Fig. A) shows the regional distribution of phosphorites over nearly the entire

southern margin of Yangtze platform. Present at the same stratigraphy level, the phosphorite intervals on the Doushantuo Yangtze platform appear associated with an event affecting the entire platform and inducing favorable conditions for the phosphogenesis. Neoproterozoic and Cambrian economic phosphorite deposits are attributed to global events (Cook and Shergold, 1986; Gubanov, 2002) such as the metazoan radiation and related production of organic matter. Other authors attribute phosphogenesis to Precambrian tectonic. The geometry in horsts and grabens of passive margin creates numerous shallow marine platforms with favorable conditions for high organic productivity (Yiqing, 1984; Liang and Chang, 1984; Yueyan, 1986).

The sedimentation and preservation of phosphorite intervals depends of the depositional conditions; however, the saturation of the environment in phosphorus may have a global origin. Therefore, phosphorites deposited at the same stratigraphic interva represent the same event of saturation. Then, because synchronous phosphorites of the Doushantuo Formation on the Yangtze platform are good time markers and may be used as correlation tools.

Phosphorites as sequence-stratigraphic markers?

The sequence-stratigraphic analysis highlights the recurrence of phosphorite interval No.1 at the top of the parasequence I, while the phosphorite interval No. 2 marks the base of the parasequence III. The variations of sea level may have influenced the phosphogenesis by a variation of sediments supply (Fig. B).

During the drop of the sea level, the rim at the margin protected the Yangtze platform shelf inducing an important energy decrease on the inner shelf. Therefore, the entire platform situated at the back of the edge barrier records dominant suspension settling sedimentation or sediment starvation, which are favorable conditions for phosphogenesis. Moreover, the regression induced an increase of sliding in the slope and therefore an increase of sediment supplies, which may explain the absence of “in-situ”-formed phosphorite interval No.1 in the slope sections.

The starvation of sediment related to the transgression facilitated the phosphogenesis in the slope environment where the phosphorite interval No. 2 is thin but present in several sections. On the shelf, the phosphorite interval No. 2 is represented by reworked facies interpreted as shoal environment (Weng’an section, Guizhou province; Zhongling and Yangjiaping sections, Hunan province). The development of these facies implicates a shallower bathymetry than the average bathymetry of the platform floor. Thus, the phosphogenesis on the shelf during transgressive period occurs on the highs of the shelf irregular floor. This is a mechanical reworking of previous deposits. However, phosphoritic-coated grains indicate that apatite saturation was reached.

Because phosphorite sedimentation is the combination of both sea level variations and depositional conditions, the phosphorites may be used as sequence stratigraphy markers for the 2nd order variations of sea level.

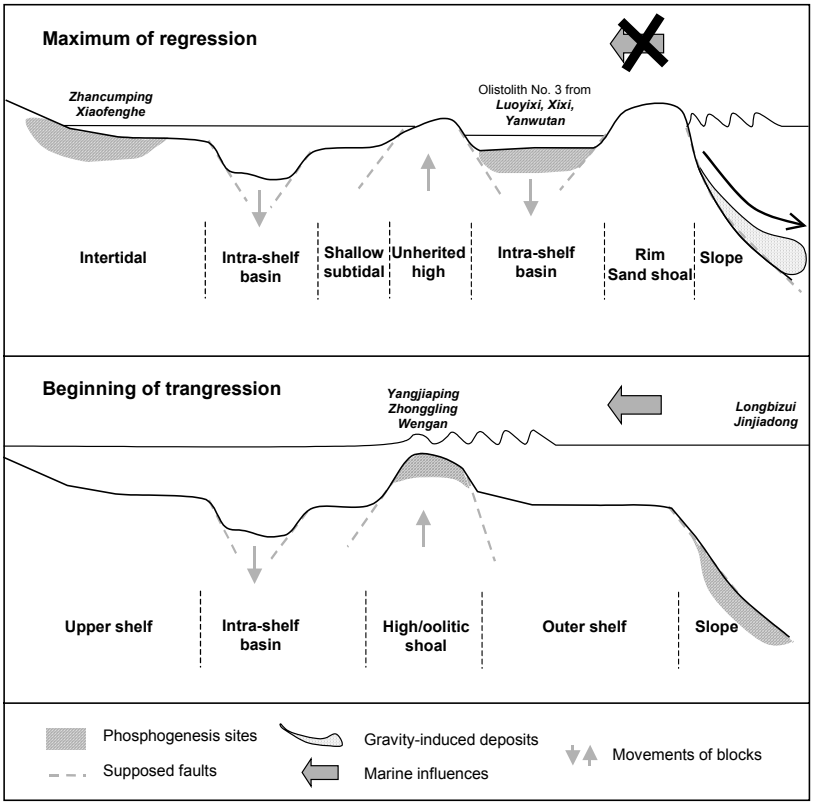

Fig. B. Possible explanation for the location of phosphorite intervals on the platform according to the major variation of sea level