# Appendix 5. Formation of precipitated sediments during the Ediacaran

Lithologies on the Ediacaran marine Yangtze platform include carbonates, shales, cherts, phosphorites, and rare evaporites, similar to Recent or Phanerozoic platforms. However, the formation of the bioprecipitated sediments (cherts and carbonates) may have varied from the recent because of the absence of secretor organisms.

**Limestones and dolomites**

During the Proterozoic, except for direct chemical precipitation, microbial mediation or diagenesis were the only processes of carbonate formation. Sochava and Podkovyrov (1995) proposed a hydrothermal alteration of the oceanic crust as source of $Ca^{2+}$, and a tectono-magmatic activity origin for $CO_2$. Studying recent sediments, Riding (2000) concluded that the precipitation of microbial carbonate needed a favourable saturation in $Ca^{2+}$ and $CO_2$, and a combination of abiotic and biotic factors. Bacteria metabolism increases the pH and causes the precipitation of calcium carbonate in ambient water (Riding, 2003). The ratio of dolomite/limestone depends on the $Ca^{2+}$- and $CO_2$-concentration in the environment (Sochava and Podkovyrov, 1995). An increase of $Ca^{2+}$- or decrease of the $CO_2$-flux into the atmosphere-hydrosphere system diminishes the dolomite/limestone ratio; therefore, this ratio decreases continuously from the Precambrian to the present. Very few places in the world show actually primary dolomite precipitation. But it is probable that some Ediacaran dolomites may have been primary deposited. By analogy with the present and because the carbonates reflect seawater chemistry, the chemical composition of the Precambrian ocean may have been similar to modern lakes and rivers rather than to modern seawater (Knoll et al., 1993).

**Phosphorites**

Phosphorites are organic-rich sediments characterised by $P_2O_5$ above 20%, resulting from the presence of fluoroapatite ($Ca_5(PO_4)_3F$) in the uppermost ten centimeters of sediments. Their formation requires a significant supply of organic matter (Baturin, 1982) and its partial decomposition in a semi-anoxic environment (Trappe, 1998; Trappe, 2001). Low rates of sedimentation (Liang and Chang, 1984; Yiqing, 1984; Föllmi et al., 1991; Trappe, 1998; Trappe, 2001) favour phosphorite precipitation. Föllmi et al. (1991) show that the concentration of dissolved phosphorite in porewater is enhanced by microbial activity, physico-chemical cycling, and by decay of buried organic matter. The majority of economic concentrations of phosphorites are Ediacaran or early Cambrian age (Cook and Shergold, 1986). During this time interval, phosphogenesis appears to have been related to global events allowing a worldwide precipitation of phosphorite on marine platforms (Cook and Shergold, 1986; Donnelly et al., 1990; Gubanov, 2002). Some authors related phosphogenesis to the metazoan fauna „explosion" and to episodic production of organic matter (Cook and Shergold, 1986). For Liang and Chang (1984), Yiqing (1984), Yueyan, (1986), the Rodinia breakup, creating uplifts and depressions, resulted in numerous shallow marine platforms favourable to phosphogenesis. Phosphorite facies are in many aspects similar to the carbonate facies. Because they are very hard, phosphorites are ideal sediments for soft-body fauna preservation because they create early and rapidly a hard matrix around a decaying fossil. As a case in point, the remarkable well-preserved Ediacaran embryos are preserved due to early diagenetic phosphoritization (Xiao et al., 1998).

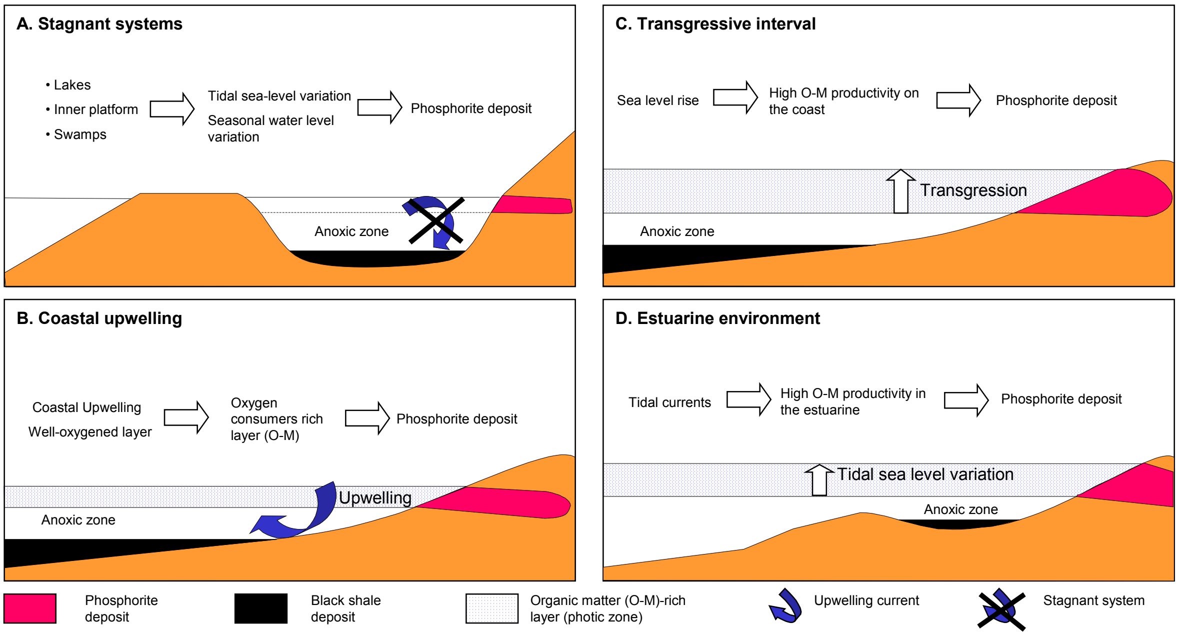


**Fig. A.** Depositional conditions for black shales and phosphorites (after Boer, 1991; Wetzel, 1991)

### Chert

The silica cycle during the Precambrian differed from the present-day cycle by a lack of a biologic sink (Siever, 1992). Dabard (2000) postulated that some cherts may precipitate in a saltwater/freshwater-mixing zone by a dissolution-precipitation mechanism controlled by relative sea level changes. Even through tectonics, weathering (sediment supply) and hydrothermal activity (Zhou et al., 1994) are favourable factors, bacteria and/or algal mediation is an essential precursor of silicification (Siever, 1992; Dabard, 2000). Chert distribution is often correlated with organic matter abundance (Maliva, 2001). Siever (1992), Sugitami (1992), and Sugitami et al. (1998) document that the association of carbonates, sulphates (gypsum and anhydrite) and organic matter facilitates early silicification, and, by analogy with the present, silicified sediments in the past may have precipitated under arid climate. Where silicification occurred, early sedimentary structures may be well preserved (Bartley et al., 2000).