The type Ludlow Series: Palynofacies

Although based on the record of microscopic plant and animal remains, the application of palynofacies to correlation is distinct from normal biostratigraphical methods. Instead of relying on the stratigraphical ranges and occurrence of identified taxa, methods based on palynofacies use changes in the overall composition of palynological assemblages. If a sequence of such changes forms a consistent pattern through several sections, the possibility of using that pattern for correlation may result. In this respect, the use of palynofacies for correlation constitutes a form of event stratigraphy.

Few studies of palynofacies have been made on Ludlow strata in Britain, but Richardson & Rasul (1990) investigated palynofacies in highest Ludlow and lowest Prídolí rocks of the Welsh Borderland and Wales. The method used by Richardson & Rasul (1990) employed two ratios. The **Marine Influence Index** is the ratio between marine organic-walled microfossils (acritarchs, chitinozoa, scolecodonts) and land-derived sporomorphs (cryptospores and miospores), used as a general indicator of environment and particularly proximity to shore. It expresses the marine component as a percentage of the total assemblage based on counts of specimens, and is calculated by:

$$\frac{\text{acritarchs + chitinozoa + scolecodonts}}{\text{(above) + total sporomorphs}} \times 100$$

The **Inshore Index** is based on the ratio between those marine palynomorphs thought to be more abundant in nearshore environments (sphaeromorph acritarchs, tasmanitids, *Micrhystridium*) and those that are thought to be more typical of open marine environments (netromorph, acanthomorph and polygonomorph acritarchs). It expresses the nearshore component as a percentage of the whole, and is calculated by:

$$\frac{\text{sphaeromorphs + tasmanites + micrhystridia}}{\text{(above) + outer neritic forms (netro-, acantho-, polygonomorphs)}} \times 100$$

In addition, Richardson & Rasul (1990) observed that different groups or genera of acritarchs might dominate the acritarch component of individual samples, and introduced the concept of acritarch phases based on the dominant component. The most important phases in the upper Ludlow and lower Prídolí strata of the Welsh Borderland are the polygonomorph phase, represented mainly by species of *Veryhachium*, the *Visbysphaera* phase and the sphaeromorph phase.

At Weir Quarry, Downton [SO 4560 7525], about 6 km W of Ludlow, Richardson & Rasul (1990) recorded distinct changes in the acritarch phases, in the Inshore and Marine Influence indexes, and in the type and nature of organic matter.

(continued...)

The type Ludlow Series: Palynofacies (continued)

- The acritarch phases show a progression from polygonomorph to *Visbysphaera* to polygonomorph phases in the highest 2 m of the Upper Whitcliffe Formation at Weir Quarry. The sphaeromorph phase dominates in the Downton Castle Sandstone Formation.

- A major oscillation in the Marine Influence Index and spore abundances (decrease in Marine Influence Index, increase in percentage of spores) occurs about 1 m below the top of the Upper Whitcliffe Formation. This was interpreted as representing a regressive event; an alternative possibility, that it represented a storm event, was considered but discounted (Richardson & Rasul 1990, p.679).

- Data from the Downton Castle Sandstone Formation were interpreted as indicating a sudden shallowing (regression) across the base of the Ludlow Bone Bed Member, followed by deepening through the Platyschisma Shale Member and gradual shallowing through the Sandstone Member.

- A dramatic decrease in the Marine Influence Index between adjacent samples at the top of the Platyschisma Shale Member, 1.82 m above the base of the Downton Castle Sandstone Formation, was attributed to a storm event (the *Platyschisma* event).

Richardson & Rasul (1990) thus identified two regression events and a storm event based on palynofacies analysis. They noted similar patterns in the Gorsley, May Hill and Usk inliers, south and east of Ludlow in the shelf succession, and at Long Mountain west of Ludlow on the margin of the Welsh Basin. They also noted broad similarities in the Whitcliffe Road section at Ludlow, although with some differences; there is, for example, a more abrupt change in the proportion of sporomorphs at Weir Quarry (from 2.5% in the Upper Whitcliffe Formation to 50.5% in the Downton Castle Sandstone Formation) than at Ludlow (14.5% in the Upper Whitcliffe Formation, 25.5% in the Downton Castle Sandstone Formation).

In a discussion of Richardson & Rasul's paper, Ainsworth (1991) pointed to the likely complexity of processes affecting sedimentation in stormy shelf seas, and cautioned that the patterns observed by Richardson & Rasul could be explained by autocyclical processes, such as sediment recycling and transport during storm events, rather than allocyclical processes such as sea level changes. Ainsworth concluded that overall trends in palynofacies curves were more likely to reflect sea level histories than spikes in the data. In reply, Richardson & Rasul (*in* Ainsworth 1991) pointed out that the broad offshore-onshore pattern across the Upper Whitcliffe-Downton Castle Sandstone boundary was distinct and repeated, with some variation, in sections from both shelf and basinal areas. They had earlier concluded (Richardson & Rasul 1990) that the succession of acritarch phases followed the same pattern throughout the area studied, and that the succession of phases might prove useful for fine-scale, intrabasinal correlation.

(continued...)

The type Ludlow Series: Palynofacies (continued)

Ainsworth, R.B. 1991. Discussion on palynofacies in a Late Silurian regressive sequence in the Welsh Borderland and Wales. *Journal of the Geological Society, London*, **148**, 781-784.

Richardson, J.B. & Rasul, S.M. 1990. Palynofacies in a Late Silurian regressive sequence in the Welsh Borderland and Wales. *Journal of the Geological Society, London*, **147**, 675-686.

Return to beginning of 'Methods of correlation'.
Return to 'The Ludlow Series (Upper Silurian) of the type area - introductory page'.

[Author: SGM]