Review of 'Fauna dynamics of monograptid graptolites in the Late Silurian of northeastern Poland' by Dagmara Chmielarz

This PhD thesis comprises four chapters, all dealing with various aspects of finely-preserved graptolites recovered, mainly by acid-extraction, from core material of the Goldap-1 borehole, drilled through Late Silurian strata in north-east Poland.

The thesis is written entirely in English, and the candidate is to be congratulated for making this effort to write a lengthy scientific work in a language that is not her mother tongue. The English is mostly clear and comprehensible, though I have made a number of suggestions regarding grammar and phrasing that should be considered when this work is prepared for publication in external journals.

The work is overall well structured and well illustrated, and ranges across palaeoecological, biostratigraphic, palaeoenvironmental (geochemical) and taxonomic analysis. This covers a commendable range of study. Altogether, I consider that the work merits the award of a doctoral degree. From the four chapters, I think that three substantial external publications could ensue. My comments below are mainly aimed at providing some suggestions to help in the production of manuscripts for eventual external publication.

Chapter 1

The first chapter, concerning 'faunal dynamics', comprises a quantitative, as well as presence/absence, analysis of the graptolite fauna recovered. This is the most novel aspect of the thesis as a whole, and is eminently publishable overall, with some good clear summary diagrams of the abundance data. It clearly shows that graptolite assemblages were temporally variable and fluctuated widely; hence, the suggestion that the '*leintwardinensis* event', when the saetograptids disappeared, was mediated through replacement rather than through an extinction event and subsequent re-radiation, is defensible. Certainly the species that flourished after the event, such as *Pristiograptus* and *Bohemograptus*, had long been a component of Ludlow graptolite assemblages.

However, there are some aspects that could be examined further: notably, the environmental setting, both locally and globally. How, for instance, (if at all) does the lithological change from limestone to mudstone that seems to coincide with the '*leintwardinensis* event' reflect the marine regression event noted (e.g. p. 23) by the candidate? For a regression to coincide with a drop in species diversity seems to have been a common pattern in the history of graptolites. The local evidence here may be able to shed some light on this event.

More minor comments include: (1) the genus *Pristiograptus* does not originate in the *riccartonensis* Biozone of the Wenlock as stated (p. 15) but earlier, in the Llandovery. (2) In the discussion of the genus *Monoclimacis* (p.19), the nature of the apertural lobes (or are these thecal hoods?) should be clarified – and, is there

a gap between the ranges of *premicropoma* and *micropoma*? (3) the discussion of the relative abundances of various species on p. 29-30 is detailed, by it should be more clearly stated which species co-occur and which tend to be mutually exclusive.

2. Local palaeoenvironmental changes across the Gorstian/Ludfordian boundary.

This chapter compares the temporal record of graptolite patterns in the core with geochemical data (trace element and stable carbon isotope values). It analyzes, methodically, a good deal of systematically collected data, and uses the results to come to some conclusions about changes in parameters such as palaeoredox state. It also presents some petrographic data obtained from a set of thin sections cut from representative core samples.

The data is potentially useful, and has been clearly laid out and systematically described. Its value and significance would be enhanced by comparison with some more rather simpler data, and this might be considered prior to publication. For instance, the overall lithology of the core is simplified in the log to limestone/marlstone versus a mud/siltstone unit at the top. However the thin section data (table 1) suggests greater lithological diversity, with mudstone layers within the limestone also. Could any of this diversity be logged by closer lithological/sedimentological inspection of the core? And, burrows are noted in only a couple of places – if so are these brief 'oxic' intervals within an overall longer interval of sea floor anoxia? I realize that these factors are difficult to pick up some in some lithologies, but given their palaeoenvironmental importance (and relevance to geochemical proxies) some comment on this would be useful.

Furthermore, in looking for patterns of mud/carbonate ratios, major element (e.g. Si, Al, Ca etc) would have been useful as well as trace element ratios – or even estimations of carbonate content obtained by dissolution- or heating-based methods. Similarly, organic contents can be measured more directly than through subtle geochemical trace element-based proxies.

Regarding the isotopes, in general the carbon isotope data in rocks from this age should be broadly reliable, while the oxygen isotope data (because of diagenetic changes) will not be – and this should be clearly stated (and, indeed, there is a case for omitting the oxygen isotope data completely for this reason, when the data is published). The carbon isotope data itself in this study shows little change, except for one 'spike' low in the succession; this, though, is only from one sample, and so may mark a very local change (connected with microbial activity, for instance) rather than anything more widely correlatable.

The candidate has done her best with the data, and discussed it using the relevant literature. Although no very firm or striking conclusions could be reached, it would be worth focusing attention more clearly on one of the main questions, which is what does the lithological and biological change at the Gorstian/Ludfordian boundary really represent? This needs to be more directly

addressed (including in the abstract) – even if the answer is only 'the data do not allow us to constrain that event yet'.

3. Graptolite biostratigraphy

This is on the whole a straightforward, concise and useful summary of the graptolite biostratigraphic evidence, providing ranges of the graptolites obtained through the Wenlock and Ludlow strata of the borehole (and that is, covering a greater stratigraphical range than in the first two chapters. This seems a generally reliable and publishable account, producing a biostratigraphy that has been clearly set within an international framework.

I have a few comments here:

The *Cyrtograptus perneri* Biozone is very thin – is it justifiable as a separate unit?

In the *Cyrtograptus lundgreni* Biozone, there seems to be justification for an upper unit (a subzone?) characterized by *Testograptus testis*. And, in the 8 m gap noted at the top – is it possible that there is (as one might expect at such a level) the *nassa* Biozone? - has this biozone been recognized by earlier work – and is it present in adjacent boreholes? And – is there really a *Torquigraptus* sp. present here (see also Chapter 4), or is this a *Cyrtograptus* fragment? It would be stratigraphically a very high level for this taxon.

In the *Saetograptus leintwardinensis* Biozone, there are some discrepancies between the ranges as noted in the text (*P. tumescens* and *S. chimaera*) and those shown on the range-chart.

In the *Neocucullograptus kozlowskii* Biozone, *Linograptus posthumus* seems to occur by itself in the upper part of the biozone – perhaps a useful subzonal indicator?

4. Taxonomy

This presents brief systematic descriptions and illustrations of the taxa listed in Chapter 3. The illustrations are very good (though a little dark, mostly, in my copy of the thesis). The descriptions are generally adequate, but are a little too concise to add much new information over and above that which has already been published on these taxa in the literature; there is some morphometric data, but not really enough to, for instance help establish robust ranges of variations. There are some sections also that are not particularly necessary, such as the 'Associations' (which can be read, in any event, off a range chart). No new taxa are described – perhaps unsurprising, now, in strata that have had a long history of study. My feelings about his chapter are that it is effective as a PhD thesis chapter but that it does not include enough new (or very detailed) information to recommend it as a future 'stand-alone' publication. However, combining the excellent illustrations within it, together with brief taxonomic

notes/measurements as appropriate, with the biostratigraphic ranges of Chapter 3 would enhance the latter and result in a good and effective overall publication. However, the illustrations would have to pack in the illustrations more efficiently – currently there is some waste of space, allowable in a thesis but not kindly looked upon by publishers of external journals.

Detailed comments include:

It would be useful to more clearly establish how *Monograptus priodon* and *M. flemingii* were distinguished – that has always been a problematic distinction to make; currently the discussion is a little non-specific.

Similarly, the differences between the *dubius* group taxa need to be sharper and clearer (with mention of the difficulties in comparing SEM-based and rock-based data, as appropriate). Currently it is unclear exactly how the various taxa in this group were distinguished.

In the description of *Saetograptus leintwardinensis*, could the 'late survivors' possibly be reworked specimens?

For all the chapters, a number of detailed comments and suggestions, many grammatical, are written on the ms, which I will be happy to pass on to the candidate.

Jan Zalasiewicz 22/4/2014.