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FLYSCH AND MOLASSE: THE ELUSIVE MODELS. A DISCUSSION[1]

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Miall (1984) argues for abandonement of the terms flysch and molasse which "convey more confusion than useful meaning", "are living fossils representing the virtually extinct geosyclinal theory", "are quite inadequate to convey the breadth and depth of knowledge that has now accumulated about sedimentation and plate tectonics", and whose definitions "when examined in a rigorous plate tectonics context (...) break down in several ways".

His main arguments are: (1) their tectonic setting has not been clearly defined, (2) the supposed relationship to orogenic stages is meaningless, and (3) the terms are not consistently used for particular lithofacies assemblages. As far as flysch is concerned, the arguments 1 and 2 are not pertinent to the dominant current use of the term, and for argument 3 only evidence to the contrary is presented.

The dominant current use of the term flysch is defined by Miall as one linking tectonic and stratigraphic concepts; a glossary definition and a list of papers are given as the evidence for this. However, the AGI *Glossary of Geology* (Bates & Jackson, 1980) definition quoted by Miall is only a fusion of the second and the third meanings given there. The first meaning, omitted by Miall without acknowledging and explaining it, reads: "a marine sedimentary facies characterized by a thick sequence of poorly fossiliferous, thinly bedded, graded deposits composed chiefly of marls and sandy and calcareous shales and muds, rhythmically interbedded with conglomerates, coarse sandstones, and graywackes".

None of the papers in the list that follows after the definition (I could not check the last two papers, but these seem to deal with molasse) discusses the definition of flysch. None conflicts with the *Glossary* definition omitted by Miall. None of the authors relates the term flysch to tectonic setting of deposition or to orogenic stage, and some do the contrary.

For example, Stefanescu (1980) writes of deposits in flysch facies laid down before and during main folding (see his fig. 2). His view on the definition is included in another paper (Sandulescu *et al.*, 1981). "In our oppinion the flysch definition must rely on morphological and lithological features and not on

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genetical, tectonical or stratigraphical ones". Burchfiel and Royden (1982) describe "underformed flysch units (Podhale flysch) that lie unconformably on the structures of the inner Carpathians" and preorogenic flysches as well.

The definition by Reading (1972) is quoted by Miall to illustrate his argument 1. The definition includes "geosyncline" as a tectonic setting of flysch deposition and is claimed representative for two other papers (Mitchell & Reading, 1978; Nachev, 1980). However Mitchell and Reading (1978) after quoting this definition discuss it and conclude: "we prefer to define flysch independently of tectonic setting...". Nachev (1980) criticized the concepts relating flysch to some specific tectonic setting or orogenic stage, but he did not discuss the definition. He had done that in another paper (Nachev 1976) and concluded that the definition by Hsü (1970, see below) "has been widely introduced into practice and is now recommended".

Two important papers devoted to the problem of flysch definition are included in Miall's reference list (Dżułyński & Smith, 1964; Hsü, 1970), but their substance is not discussed. Both define flysch as a facies. A tectonic setting is included in Hsü's definition, but this is one of the present occurrence and not of deposition.

Thus, the dominant current use of flysch, as determined on the basis of the papers included in Miall's reference list, is as a facies term and arguments 1 and 2 are not pertinent to it.

Argument 3 is that flysch is not consistently used for a particular lithofacies assemblage. The respective chapter, however, contains no proof for this, and the following chapter starts with: "there is no doubting that flysch and molasse represent widespread, distinctive lithofacies associations...". Indeed, there are few examples in the literature of a dispute about attribution of particular deposits to flysch on the grounds of their descriptive features. The debate on the meaning of the term flysch rages, however, for more than a century. The debate concentrates mainly on the interpretative connotations of the term, mainly tectonic ones, although paleobiological and stratigraphical aspects also were being included.

Since the early history of the term, there persisted a stream (although not ever the mainstream) of using the term as a descriptive facies term. This use has been followed in papers on regional geology as well as in specialized papers, including tectonic ones, and the changing concepts in tectonics and in other fields did not affect this use.

On the other hand, it is mainly those considering the tectonic aspects as inherent with the flysch definition, who object against the use of the term. Some quotations from prominent students of flysch who avoid using the term, illustrate the point. For Walker (1970) "flysch can be considered as the preparoxysmal fill of a geosyncline, the dominant sediment type is turbidite, but depending on the relative rates of subsidence, supply of sediment, and tectonism, other facies can be present". Skipper and Middleton (1975) qualify a discussed formation as a "flysch in the descriptive sense of Studer". For Kelling

and Stanley (1978) "the term flysch (...) has lost much of its initial utility and its continued use must now be largely a confession of ignorance", and "if it is to be used at all, the term flysch now should be confined to descriptive, nongenetic use at the outcrop".

Summing up, the term flysch conveys a clear meaning for those who use it for a facies characteristic of orogens. Those for whom the term bears also interpretative tectonic connotations, object to using it.

Doubts exist about using the term for deposits found in submarine fans, trenches or other settings in modern marine basins (see Stanley, 1974). Te definitions by Dżułyński and Smith (1964) and Hsü (1970) exclude these deposits from flysch despite of their assumed facies equivalency. The problem of using or not the facies term for these deposits is not urgent at the moment, as only one deep-sea analogue of flysch has been drilled until now (Bouma *et al.*, 1985). Whatever the name will be used for the submarine flysch *in spe* with its increasing study, there remains enough strata in orogenic belts on land for which a single, descriptive term remains useful.

Miall's proposal of giving each "flysch and molasse pulse" a separate lithostratigraphic name does not satisfy the need for such a general descriptive term. In his final suggestions, Miall (1984) uses the term flysch, apparently finding no substitute for it, when he refers to the totality of deposits in this facies.

I agree with Miall that the tectonic connotations in the definition of flysch are confusing. The initially descriptive term flysch gained its interpretative tectonic connotations when used for the then novel geosynclinal theory. As Miall (1984) observed, the term survived the geosynclinal theory. As a descriptive facies term it is capable of surviving the plate tectonics too.

REFERENCES

Bates, R. L. & Jackson, J. A. (eds.), 1980. *Glossary of Geology*, 2nd ed. Am. Geol. Inst., Falls Church, Virginia, 749 pp.

Bouma, A. H., Coleman, J. M. & DSDP Leg 96 Shipboard Scientists, 1985. Mississippi Fan: Leg 96 Program and Principal Results. In: Bouma, A. H., Barnes, N. E. & Normark, W. R. (eds.), *Submarine Fans and Related Turbidite Systems*. Springer, New York, pp. 247–252.

Burchfiel, B. C. & Royden, L. 1982. Carpathian foreland fold and thrust belt and its relation to Pannonian and other basins. *Am. Assoc. Petrol. Geol. Bull.*, 66: pp. 1179–1195.

Dżułyński, S. & Smith, A. J., 1964. Flysch facies. *Rocz. Pol. Tow. Geol.*, 34: 245–266.

Hsü, K. J., 1970. The meaning of the word flysch – a short historical search. In: J. Lajoie (ed.), Flysch sedimentology in North America. *Geol. Assoc. Can. Spec. Pap.*, 7, pp. 1–11.

Kelling, G. & Stanley, D. J., 1978. Sedimentation in submarine canyons, fans and trenches: appraisal and augury. In: Stanley, D. J., Kelling, G. (eds.), *Sedimentation in Submarine Canyons, Fans and Trenches*. Dowden, Hutchinson & Ross, Stroudsburg, Penn., pp. 377–388.

Miall, A. D., 1984 (issued in 1986). Flysch and molasse: the elusive models. *Ann. Soc. Geol. Polon.*, 54: 281–291.

Mitchell, A. H. G. & Reading, H. G., 1978. Sedimentation and tectonics. In: Reading, H. G. (ed.), *Sedimentary Environments and Facies*. Blackwell Sci. Publ., Oxford, pp. 439–476.

Nachev, I., 1976. On the types of flysch in Bulgaria (in Bulgarian, English summary). *Paleont. Stratigr. and Lithol.* 4: 75–87. Sofia.

Nachev, I. K., 1980. Flysch and geodynamic environments. In: Tektonische Bewegungen, sedimentäre und magmatische Prozesse der Flysch- und Molasseetappen des variszischen und alpidischen Zyklus in Zentral- und Südosteuropa sowie in ausgewählten Gebieten der UdSSR. *Veröff. Zentralinst. Physik der Erde,* 58: 47–62.

Reading, H. G., 1972. Global tectonics and the genesis of flysch successions. *24th Int. Geol. Congr., Montreal, Sect. 6,* pp. 59–66.

Skipper, K. & Middleton G. V., 1975. The sedimentary structures and depositional mechanics of certain Ordovician turbidites, Cloridorme Formation, Gaspe Peninsula, Quebec. *Can. J. Earth Sci.,* 12: 1934–1952.

Stanley, D. J., 1974. Modern flysch sedimentation in a Mediterranean island arc setting. In: Dott, R. H. Jr & Shäver, R. H. (eds.), Modern and Ancient Geosynclinal Sedimentation. *SEPM Spec. Publ.* 19, pp. 240–259.

Sandulescu, M., Stefanescu, M., Butac, A., Patrut, I., Zaharescu, P., 1981. Genetical and Structural Relations between Flysch and Molasse. *Guide to Excursion A5, Carpatho-Balkan Geological Association XII Congress, Bucharest – Romania 1981,* 95 pp.

Stefanescu, M., 1980. Relationship between olistostrome and flysch: An example from East Carpathians. In: Tektonische Bewegungen, sedimentäre und magnetische Prozesse der Flysch- und Molasseetappen des variszischen und alpinischen Zyklus in Zentral- und Südosteuropa sowie in ausgewählten Gebieten der UdSSR. *Veröff. Zentralinst. Physik der Erde,* 58: 63–70.

Walker, R. G., 1970. Review of the geometry and facies organization of turbidites and turbidite-bearing basins. In: Lajoie, J. (ed.), Flysch sedimentology in North America. *Geol. Assoc. Can. Spec. Pap.,* 7, pp. 219–251.