Dr. W. Schnabel, Geol. Survey of Austria

Flysch-Problems

(Abstract)

The expression "Flysch" was first used by Studer (1827) in the Simmen-Valley of Switzerland, it characterizes rocksequences of sandy-silty nature, which incline to slide when wheathering and usually form soft regions.

Now, 1970, after 10 years of world-wide and intensive discussion no final definition of "Flysch" can be given. Flysch-deposits are characterised by grade-bedded series of psammitic — pelitic detritus (turbidites!), which are usually found as remarkable sequences, as for instance the Flysch formations of the East-alpine and Carpathian "Flysch-zone". Due to this thick formation, which inevitably presupposes sedimentation in sinking or deep basins, a certain relation to tectonical events is given. On these criteria petrographers base their definition of Flysch as Wieseneder (1962), who regards Flysch as a "certain lithofazies independent of any particular period, which has been formed in geosynclinals at any time".

Seilacher (1958) goes even further when he includes the small amount of mega-fossils and large quantity of trace-fossils and primitive foraminifera in his definition. According to his definition, Flysch has to have a special Lithofacies (graded bedding ...), Biofacies (trace-fossils, no mega-fossils ...) and Tectofacies (great thickness originating in lateral basins of geosyncline before or during the first foldings and tectonical movements of the orogen). Frequent association of these given tectonical, sedimentological and biological features at various points of the earth history demonstrates the significance of the flysch concept. Examples intermediate to other facies types are relatively rare and differ from true flysch in either one (tectonically, sedimentologically or biologically aberrant flysch) or two (flysch-like formations) of the three aspects (Seilacher, 1967).

The clearest answer to the question of the genesis of Flysch-deposits is given by Kuenen & Carozzi (1953) in their theory of turbidity currents. Material, deposited in adjacent areas slides down as a suspension into the deeper sea, where the suspended material settles down according to grain-size and weight, causing graded bedding. If there was not enough energy to transport the whole material in a suspended condition, Fluxoturbidites are formed (partly sliding movement causing incomplete gradation, Djulynski et al., 1959).

The turbidity current forms current-marks into the clay on the bottom, which reveals the transport direction. In the case of the creation of the alpine flysch-zone the direction of material-transport has changed a few times, which for instance was observed by Hesse (1965) for the Bavarian flysch. Besides the organic traces, anorganic structures (ripple-marks ...) where present in the clay-sediment on the sea floor, which

can be partly conserved by the following turbidite. The replicas of all structures on the bottom of a layer can be called basic-marks (current marks, ripple marks, organic traces, load casts ...) and must not be confused with internal-structures, which occur within a bed and are caused by different density gradient, slumpings ect. The most common phenomenon of the internal structures is the convolute bedding (POTTER & PETTIJOHN, 1963). In polish carpathian flysch SUJKOWSKI (1957) pointed out that on an average every 4000 years a turbidity current must have occured. In the Flysch of the Vienna-woods it was found, that a turbidity current extinguishes the bottom fauna and after that, the new formed floor is reinhabited, beginning with primitive agglutinated foraminifera to more and more specialised forms (GRÜN et al., 1964).

Flysch-formations are found in the alpine geosynclinal as well as in the variscian and older sequences. The flysch-zone of the eastern alps and the carpathians is very typical and well investigated (see references).

Many regions today have sedimentation with mechanism of turbidity currents (Gulf of California ...), their sediments can be compared with "fossil" flysches. (v. RAD, 1968). In the Adriatic sea we know four holocene turbidites (VAN STRAATEN, 1970).

From recent observations we know that turbidity currents occur with such great intensity and violence, that deep-sea cables are cut. The investigation of Flysch sediments, Flysch basins and their origin is thus of immediate economic interest (KRAUSE et al.).

References and selected literature

BOUMA, A. H. (1962): Sedimentology of some Flysch Deposits. — 168 S., Elsevier Publ. Comp., Amsterdam-New York.

BOUMA, A. H., & BROUWER, A. (1964): Turbidites. — Developments in sedimentology, Elsevier Publ. Comp., Amsterdam-London-New York.

DZULYNSKI, ST., KSIAZKIEWICZ, M., & KUENEN, PH. H. (1959): Turbidites in Flysch of the Polish Carpathian Mountains. — Bull. Geol. Soc. Am. *70*, New York.

GRÜN, W., LAUER, G., NIEDERMAYR, G., & SCHNABEL, W. (1964): Die Kreide-Tertiärgrenze im Wienerwaldflysch bei Hochstrass (N.-Ö.). — Verh. Geol. B.-A. 1964/2, Wien.

HESSE, R. (1965): Herkunft und Transport der Sedimente im bayerischen Flyschtrog. — Verh. Geol. B.-A., Sonderh. *G*, Wien.

HSÜ, K. J. (1970): The Meaning of the Word Flysch — A short Historical Search. — Geol. Assoc. Canada, Spec. Paper *7*, 1—12.

KRAUSE, D. C., WHITE, W. C., PIPER, D. J., & HEEZEN, B. C. (1970): Turbidity Currents and Cable Breaks in the Western New Britain Trench. — Geol. Soc. Am. Bull. *81*, 2153—2160.

KUENEN, PH. H., & CAROZZI, A. (1953): Turbidity currents and sliding in geosynclinal basins of the Alps. — Journ. of. Geol., *61*, Chicago.

POTTER, P. E., & PETTIJOHN, F. J. (1963): Paleocurrents and Basin Analysis. — 296 S., Springer-Verlag, Berlin-Göttingen-Heidelberg.

PREY, S. (1968): Probleme im Flysch der Ostalpen. — Jb. Geol. B.-A. *111*, 147—174, Wien.

RAD, U. v. (1968): Comparison of Sedimentation in the Bavarian Flysch (Cretaceous) and Recent San-Diego Trough (California). — Journ. Sed. Petrol. *38*/4, Tulsa (Oklahoma).

SEILACHER, A. (1958): Zur ökologischen Charakteristik von Flysch Molasse. — Ecl. geol. Helv. *51*/1, Basel.
SEILACHER, A. (1967): Tektonischer, sedimentologischer oder biologischer Flysch? — Geol. Rundsch. *56*, Stuttgart.
SUJKOWSKI, ZB. L. (1957): Flysch sedimentation. — Bull. Geol. Soc. Am. *68*, New York.
VAN STRAATEN, L. M. J. U. (1970): Holocene and late-Pleistocene sedimentation in the Adriatic sea. — Geol. Rundsch. *60*/1, Stuttgart.
WIESENEDER, H. (1962): Zur Petrologie der Flyschgesteine des Wienerwaldes. — Verh. Geol. B.-A. 1962, Wien.

Dr. H. P. SCHÖNLAUB, Geol. Survey of Austria

Palaeozoic Conodonts

(R e v i e w)

Conodonts are widespread in Palaeozoic sequences. They are the isolated remains of free-swimming pelagic as well as benthonic or even near-shoreliving animals. However, in a recently published paper G. SEDDON & W. SWEET suggested a modified ecologic model for conodonts as small planctonic animals, different species of which were segregated by depth stratification. As the investigations of the last 20 years have shown, these microfossils are due to their rapid evolution very valuable for dating and mapping the beds, in which they locally occur in great numbers.

Conodonts range in size of less than 1 mm up to 5 mm. They are composed of calcium phosphate and can therefore be obtained from limestones through solution of the latter in acetic acid, whereas they will dissolve in other acids, for example hydrochloric acid. They also may be observed on bedding planes of shales or cherts, where they are preserved as moulds or fragments. They may be easily recognized with help of a magnifying glass and sometimes even be determined in the field.

With regard to the morphology of conodonts three principal types can be distinguished: simple, compound (blade-like) and platform conodonts. Simple conodonts are the oldest ones and occur in the upper part of the Middle Cambrian for the first time. They are widespread throughout the Palaeozoic with a great variability. Compound conodonts can be genetically derived from simple ones. They are characterized by lateral processes or denticles in addition to the main cusp of the simple conodonts. Their first occurence is in the very early Ordovician. In various stages they are of great stratigraphic value. The platform types are generally derivable from compound conodonts, in which specific morphologic elements are widened and emphasized. Due to their rapid evolution these types are guide-fossils for parts of the Ordovician and younger systems. Especially in the Silurian and Devonian, as well as in the Carboniferous of North America and Europe conodont-zonations have been introduced on the base of the biozone concept. The worldwide validity of these zones