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Correlation of Prevariscan and Variscan events of the Alpine-Mediterranean mountain belt

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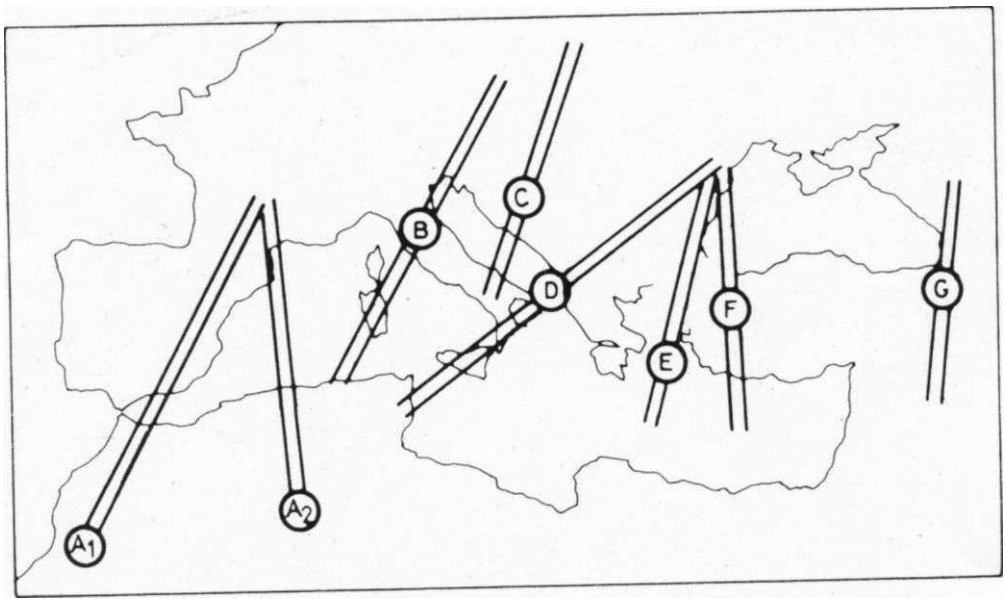

EDITED BY :
F.P.SASSI with the collaboration of R. BOURROUILH

INST. MINERALOGY AND PETROLOGY - UNIVERSITY OF PADOVA - ITALY

LAB. GEOLOGIE-SEDIMENTOLOGIE - UNIVERSITE DE BORDEAUX I-FRANCE

PERMIAN REEFS IN YUGOSLAVIA

A.RAMOVS

Institute of Geology and Palaeontology, School of Science and Technology, University Edvard Kardelj, 61000 Ljubljana (Yugoslavia)

J.SREMAC

Department of Geology and Palaeontology, Faculty of Science, University of Zagreb, klOOO Zagreb (Yugoslavia)

Reefs in the Permian of Slovenia

1) Karavanke Mountains

About 30 miorofacies types with different communities may be distinguished in the white, pink and red Lower Permian Trogkofel reef limestone in the Xarawanke Mountains. The largest and most important reef is situated in the gorge DolXanova soteska near TrSii'. It is composed of different larger and smaller boundstone bodies consisting of different primary and secondary frame-builders.

Carinthiaphyllum kahleri (Holzer & Ramovg, 1979) boundstone forms the second pyramid above the DolSanova soteska gorge. This coral community is accompanied only by crinoid remnants and very rare fusiulinids. Frame-building coraliths, round or oval in shape, grew near one another, and are represented only by C.kahleri.

In the village of Potarje west of the Dol-2anova soteska gorge, a small patch reef built by the massive coral Yokoyamaella (Yokoyamaella) stillei was found (Holzer & Ramovg, 1979). Boundstone is light grey limestone.

In the gorge, just before the south entrance of the tunnel, a piece of the coral boundstone with Yokoyamaella (Yokoyamaella) stillei was found. This massive coral probably occurs authochtonously in one of the pyramids above the gorge.

Frame-building brachiopods are represented in some places only by large examples of Meekella irregularis, M. procera, M. evanescens, and M.depressa, together with Geyerella. These fixosessile forms are accompanied by isolated fusulinids and small crinoid remnants. The Meekella community is to be found in small pink boundstone lenses.

Some other parts of the reef core are composed of the large fixosessile brachiopod Scacchinella gigantea. Isolated crinoid remnants, fusulinids and calcareous algae could be observed in the pink limestone.

Very characteristic and rather extensive is red, pink and light grey bindstone with frequent phylloid algae (Eugonophyllum johnsoni, Anchicodium) encrusted by Girvanella and accompanied by Tubiphytes obscurus, green algae and small foraminifers. Phylloid algae mostly form 4- to 6-cm slabs and lenses, exceptionally about 15 cm. Some different communities with phylloid algae could be established.

Red biomicritic limestones with solitary corals, occasionally accompanied by small brachiopods, are further limestone types within the Trogkofel reef in the Dolz'anova soteska gorge.

In the Karavanke Mountains some fusulinid limestone types were found in the Trogkofel reef limestone.

Grey limestone lenses within the clastic Lower Permian (Sakmarian and Artinskian) sequence (black shales, quartz sandstone, quartz conglomerate, limestone lenses, calcareous breccia and conglomerate) are mostly composed of secondary frame-builders Tubiphytes obscurus and T.carinthiacus, encrusted by spongiostromate algal crusts. Tubiphytes limestone represents the most common microfacies type in the limestone lenses. This microfacies was found in more than 50 localities in the southern Karavanke Mountains between Javornis'ki rovt, Planina pod Golico and Kranjska gora. Tubiphytes as a secondary frame-builder formed build-ups with spongiostromate algal crusts in low water energy environments.

Grey, badly-sorted, oncoid grain/packstone is found only resedimented (largest oncoids: 27 x 10 mm). Crusts are built by Girvanella, red algae, spongiostromate algal crusts and very frequently by sessile Apterinella. Fusulinids and spherical schwagerinids are sporadic. This microfacies is characteristic of the Upper Rattendorf beds and may be studied in Javorniski rovt near Jesenice, in many parts of the Trogkofel breccia.

In reef and sub-reef boundstones in the Karavanke Mountains the sessile miliolid Apte-

rinella (Kochansky-Devide, 1970) Is very frequent, lying on other organisms or on the lithosubstrate. It is known only in the limestone lenses in the clastic Trogkofel development and in the Rattendorf beds in Javorniški rovt and Planina pod Golico.

It is interesting that the algal facies with Epimastopora is very rare in the southern Karavanke Mountains. Biomicrite (wackstone) with numerous Epimastopora (Kochansky-Devide, 1970), accompanied by sessile foraminifera, Tubiphytes, spongiostromate algal crusts, and echinoderm remains occur in only one locality.

Environments within the Trogkofel reef in the Karavanke Mountains have been studied in detail and will be reconstructed.

In Javorniški rovt and near Planina pod Golico only one locality with massive coral Wentzellophyllum arminae (Graf & Ramovž, 1965) could be found, in a white, unbedded, crinoidal/algal Trogkofel limestone.

In the clastic development of the Lower Permian Trogkofel formation, frequent small and large lenses, mostly formed of fusulinid Darvasites (Kochansky-Devide, 1970), secondary frame-builders Tubiphytes, sessile foraminifers and stromatolite algal crusts form frequent small and large unbedded limestone lenses.

2) **Julian Alps**

In the Julian Alps, Lower Permian coral boundstone could not be found.

Near Podkoren, small Trogkofel brachiopod lenses are composed of large fixosessile forms.

In the gully Tofov graben unbedded micritic limestone with Gyroporella, secondary framebuilders Tubiphytes obscurus, sessile foraminifers and spongiostromate algal crusts was discovered.

Very interesting Middle Permian reef limestones are expoed at Straža quarry, Straža Hill and Bohinjska Bela near Bled.

The biota of these limestones consist of: calcareous algae (solenoporaceans, dasycladaceans, epimatoporids) and problematical algae (Archaeolithoporella, Tubiphytes), smaller foraminifera (about 30 species), fusulinid foraminifera (with Neoschwagerina cratlculifera and Minojapanella), calcisponges (sphinctozoans and inozoans), brachiopods (about 20 species, also including fixosessile types such as Leptodus nobilis), bryozoans (predominantly Cystoporida and Rhabdomesonida), as well as molluscs (gastropods, pelecypods, rare ammonites), ostracods, rare trilobites, rare rugose corals and abundant crinoids (including Palermocrinus togatus) and echinoids. Tube-like microfosslls of various systematic positions may be attributed to nine morphological types.

The Straža quarry and Straža Hill exhibit a Middle Permian calcisponge/algal/cement reef (Flugel et al., 1984).

In the amphitheatral limestone wall behind the village of Bohinjska Bela, a calcisponge/algal reef prevails. Massive corals followed reef-builders. Brachiopod and Neoschwagerina lenses are the most characteristic features of this locality.

3) **Southern Slovenia**

In southern Slovenia the upper part of the Ortnek beds (= Lower Permian, an equivalent of the Trogkofel limestone of the Karavanke Mountains) composed of sandy shales and fine sandstone, is characterized by small and large dark grey limestone lenses, limestone breccia lenses, and limestone conglomerate (RamovS & Kochasnky-Devidé, 1965). Some of them are built of the cerioid coral Wentzelella osobudaniensis (east of the village of Rigelj) and others of Carinthiaphyllum crasseseptatum (Graf & Ramovs, 1965), accompanied by the calcisponge Hicorocodium elegantae (north of Hudi Konec). Sessile brachiopods Scacchinella gigantea, Scacchinella sp. and Geyerella sp. (RamovS & Kochansky-Devidé, 1965), accompanied by the solitary coral Amplexocarinia virginae (Graf & Ramovs, 1965), calcareous algae and single fusulinids, form further, small, dark-grey, limestone patch reefs.

East of the village of Levsteki near Ortnek, some light-grey limestone lenses of the boundstone structure, interlayered with the sandstone/sandy shale sequence of the upper Ortnek beds, contain the closely arranged sediment-binding organism Aeolisaccus (Ramovs' & Kochansky-Devidé, 1963). These irregular, mostly thick-walled, small tubes have the same meaning in the small mud mounds as Tubiphytes. Aeolisaccus is accompanied by the green algae Mizzia and Gyroporella, but never by Tubiphytes.

The very important sediment-binding organism Tubiphytes, near Ortnek, accompanied by Gyroporella and spongiostromate cryptalgal organisms, forms small, dark-grey limestone lenses in the upper part of the clastic Ortnek formation. This Tubiphytes-Gyroporella community is the most frequent in the Ortnek beds.

The next community in some grey limestone lenses of the Ortnek beds is the Gyroporella-Tubiphytes community.

Darvasites limestone with Darvasites citrus (Ramová & Kochasnky-Devidé, 1965), smaller foraminifera and very frequent Aeolisaccus black tubes forms a lense in the clastic Ortnek development, east of Levsteki.

4) **Central Slovenia**

The Upper Permian of Central Slovenia, **SaZar** facies, is characterized by an extensive, approx. 20 cm, Waagenophyllum indicum biostrome and small patch reefs of Richthofenla lawrenciana, accompanied by large bryozoans. Small sphinctozoan Steinmannia and ino-

zoan patch reefs accompanied by Richthofenia were found near **5az**"ar.

Reefs in the Permian of Croatia

Reef-like structures in Croatia have been found in Middle Permian sediments. Within a series of dark-grey "spotted" dolomite approx. 300 m thick, coral comunities (Waagenophyllum sp., non indicum) occur sporadically. Their lateral extent is closely limited, and they may therefore be interpreted as mounds, rather than as bioherms.

A calcisponge bioherm was found in black limestones of the cone Neoschwagerina craticulifera. Besides calcisponges, bryozoans and hydrozonans built the reef framework. Numerous large brachiopods (Martinia velebitica and Enteletes salopeki) lived among the main reef builders.

Aberrant brachiopods Keyserlingina and Leptodus built a lense (? biostrome) about 1 m thick within the productoid limestones of the same cone. Brachiopod specimens attached themselves to each other's shells or to bryozoan colonies.

Reefs in the Permian of Western Serbia

Reefs in the Lower and Middle Permian could not be detected. In the Jadar facies (western Serbia), Upper Permian bioherms of Richthofenia and a Waagenophyllum indicum biostrome are known in many localities. They occur in the same stratigraphic position as in central Slovenia (**SaSar** beds).

Reefs in the Permian of Montenegro

At the village of SustaSa (Crni Potok) near Bar (southern Montenegro), allochthonous blocks lying in Anisian beds contain very interesting Lower Permian communities. The most important rock-builder is the large fixosessile brachiopod Scacchinella gigantea, accompanied by Meekella. This boundstone is partly composed of very frequent large crinoid remnants which are not present in the Scacchinella patch reefs in the Trogkofel reef in the Dolzanova soteska gorge, Karavanke Mountains.

In the Upper Permian, the most important small patch builder is the fixosessile brachiopod Richthofenia caucasica.

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