1. Introduction

During the complex studies of global stratotype sections, and their auxiliary reference sections, it was felt that sedimentology and geochemistry had been insufficiently applied. Thus this paper tries to fill this gap and deals with a problem that has been only partly investigated in the Barrandian area. The results of current and continuing research are presented in this paper.

Three stratigraphic levels were chosen for this study: the Ludlow-Přídolí boundary interval (studied by P. Čáp in the Požáry quarry near Praha-Řeporyje, the Kosov quarry near Beroun, and the Marble quarry near Praha-Lochkov), the Silurian-Devonian boundary interval (studied by F. Vacek in the Požáry quarry near Praha-Řeporyje, Praha-Podolí, and Praha-Radotín), and the Lochkovian-Pragian boundary interval (studied by T. Vorel at Cikánka near Praha-Slivenec, Homolka near Praha-Velká Chuchle, and Černá rokle near Kosoř).

These sections were selected to demonstrate the transition of each individual boundary interval from a shallow-water to a marine basinal environment (see Fig. 1). Our discussion of the characteristics of the depositional environments, and the processes by which the limestones originated in each individual boundary interval, is based on microfacies analysis (WILSON 1975, FLÜGEL 1982) and the study of sedimentary structures and textures.

Most of these sections have been subjected to detailed biostratigraphical studies in the past, as many of them serve as international standards (CHLUPÁČ 2000a, b, CHLUPÁČ et al. 1972, 1985, CHLUPÁČ – HLADIL 2000, CHLUPÁČ – KUKAL 1977, CHLUPÁČ – OLIVER 1989, CHLUPÁČ – VACEK 2003, KŘÍŽ et al. 1986). Sedimentological research, however, was limited to only several localities (see Tab. 1).

The results have been discussed among the present authors. Each section of this paper contains partial conclusions, whereas the final general conclusions are the work of all three authors.

2. History of the research on the Barrandian limestones

Petrographical and sedimentological studies of the Early Paleozoic limestones in the Barrandian area have been connected mainly with the prospecting for mineral deposits after World War 2. Former authors have concentrated mainly on the qualitative petrography of the carbonate rocks (e. g. NÁPRSTEK 1954, PETRÁNEK 1951, 1960, KUKAL 1955). The main results of this phase of research have been summarized in papers by SVOBODA et al. (1957) and KUKAL (1964), which described the petrography, chemistry, origin, and secondary alterations (diagenesis, dolomitization, silicification) of the carbonate rocks in the Barrandian area.

Some minor papers dealing with these limestones were published in the 1970's and 1980's, such as one concerning of the origin of "stromatactis" structures (KUKAL 1971), and another on nodular limestones (KUKAL 1975). Some comprehensive texts contain chapters devoted to these Early Paleozoic limestones (KUKAL 1985, 1986).

New progress in this field began in the 1990's when updated methods, such as microfacies analysis (HLADIL 1991, 1992, VELEBILOVÁ – ŠARF 1996), isotope analysis, and the analysis of organic matter (HLADIL 1992, SUCHÝ et al. 1996), began to be used. Papers by HLADIL (1995, 1997) dealing with the facies development of the Koněprusy reef complex have been discussed by CHLUPÁČ (1998).

Recent papers have been published by FRANCŮ et al. (1998), FILIP – SUCHÝ (1999), DOBEŠ et al. (1999), HEIJLEN et al. (1999), MANN et al. (1999), and VOLK et al. (1999).

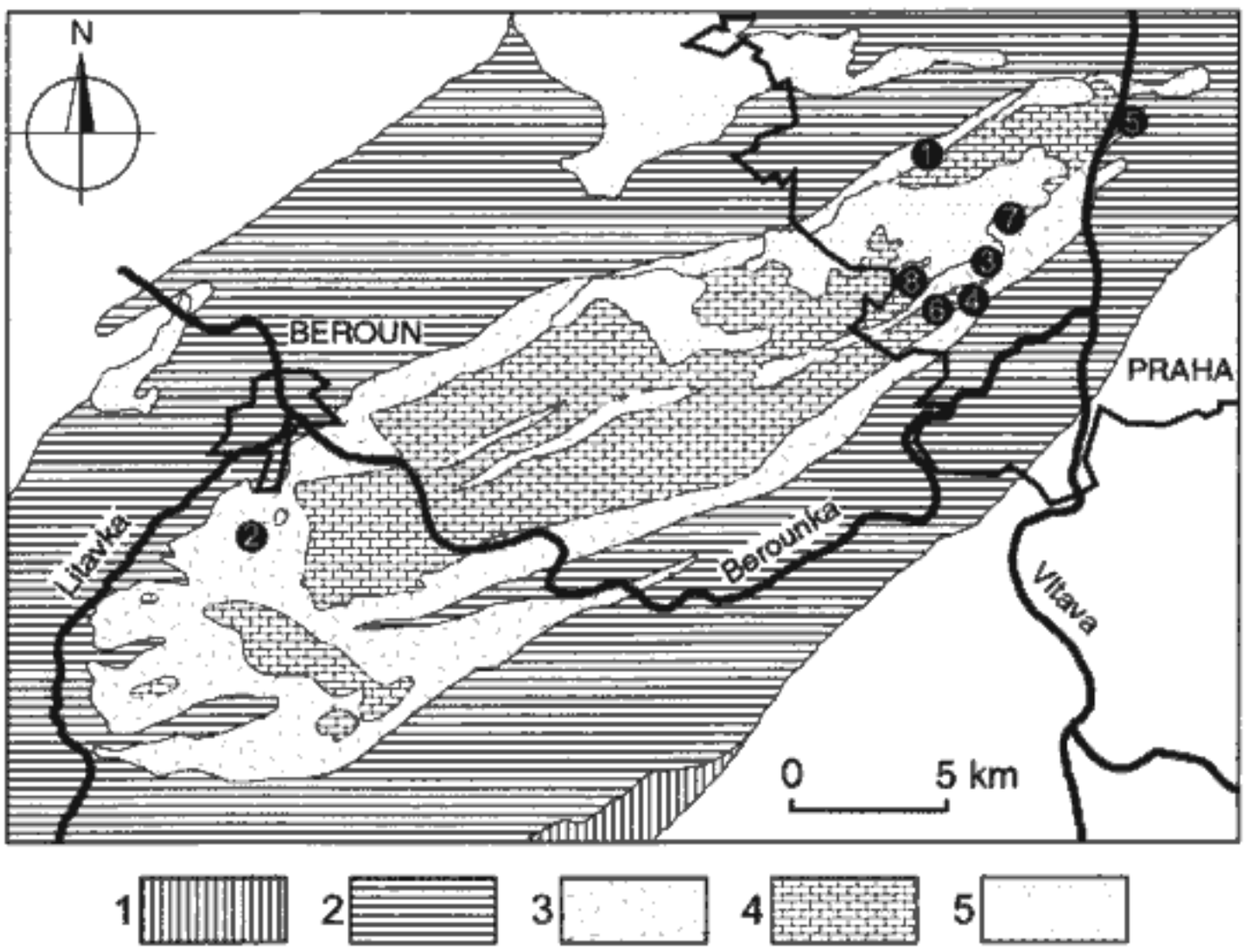

Figure 1. Map showing the position of studied localities.
1 – Cambrian, 2 – Ordovician, 3 – Silurian, 4 – Devonian, 5 – platform formations; Localities: 1 – Požáry quarry, 2 – Kosov quarry, 3 – Marble quarry, 4 – Radotín, 5 – Podolí, 6 – Černá rokle near Kosoř, 7 – Homolka quarry near Velká Chuchle, 8 – Cikánka quarry.

Table 1. Table summarizing the statute of international stratotypes of studied boundaries

Boundary	Stratotype	Ratified	Main references	Comments
Lochkovian-Pragian	Homolka quarry near Praha-Velká Chuchle	on the International Geological Congress in Washington, 1989 (CHLUPÁČ – OLIVER 1989)	CHLUPÁČ et al. (1985), CHLUPÁČ – KUKAL (1988), CHLUPÁČ (2000), WEDDIGE (1987)	the first occurrence of conodont *Eognathodus sulcatus sulcatus* in the bed No. 12
Přídolí-Lochkovian	Klonk near Suchomasty	on the 24. International Geological Congress in Montreal, 1972 (MCLAREN 1977)	CHLUPÁČ et al. (1972), CHLUPÁČ – KUKAL (1977), CHLUPÁČ – HLADIL (2000)	the first occurrence of graptolite *Monograptus uniformis* in the bed No. 20
Ludlow-Přídolí	Požáry quarry near Praha-Řeporyje	on the 27. International Geological Congress in Moscow, 1984 (BASSET 1985)	KŘÍŽ et al. (1986), KŘÍŽ (1992), CHLUPÁČ - KUKAL (1988)	the first occurrence of graptolite *Monograptus parultimus* in the bed No. 96

These studies addressed the problems of thermal history, the migration of bituminous material, and the circulation of fluids, by the use of fission-track analysis and other modern methods.

The term "microfacies" was probably first used by BROWN (1943), but only as a synonym for the microscopic composition of rocks. The numerous studies of limestone microfacies carried out from the 1950's–70's introduced a great number of individual microfacies types. CUVILLIER (1952) defined microfacies as "the paleontological and petrographical characteristics of limestones based on thin-section studies". This definition has been further supplemented by FLÜGEL (1982) who defined it as "all paleontological a sedimentological features observable in thin-sections, imprints and polished sections to enlargement 200×".

WILSON's (1975) idea of 24 standard microfacies (SMF) contributed to the unification of present research efforts. This method was first used in the Czech Republic by ELIÁŠ (1981), who studied Jurassic carbonates in northern Bohemia, the Moravian Karst, and in the vicinity of Brno. Recently, microfacies analysis has been used in the Jurassic limestones of the Silesian nappe unit in the Carpathian flysch (ELIÁŠ – ELIÁŠOVÁ 2001). Some papers deal with the microfacies analysis of the Early Paleozoic rocks of the Barranadian area, such as Hladil's study of the S/D boundary stratotype at Klonk near Suchomasty (HLADIL 1991, 1992). However, WILSON's (1975) description of SMF was not followed in that paper. VELEBILOVÁ and ŠARF (1996) studied the Lower Devonian limestones of the Prague area, and defined eight microfacies types that could be correlated with classic SMF. A microfacies study of the uppermost Choteč Limestone and the Kačák Member was carried out by BUDIL (1995). A short note on SMF in the Barrandian area was published in KUKAL (1986), while a microfacies analysis of the Middle and Upper Devonian limestones in Moravia was presented by HLADIL (1988, 1994).

3. Microfacies analysis

Sections were sampled for microfacies analysis in the interest of characterizing the main lithological types and lithological boundaries. To this end, about 100 thin sections were examined.

Petrographical characteristics were described based on microscopic studies of the paleontological content, authigenic mineralization (such as dolomitization, silicification), insoluble residues, and the clay and quartz components.

The assignment to individual SMF is based on FOLK's (1959, 1962) and DUNHAM's (1962) classifications of carbonate rocks. FOLK's (1959) classification allows the detailed definition of limestone types not only according to the amount of matrix, cement, and allochems (as is simplified in DUNHAM's 1962 classification), but also based on the degree of sorting and sediment maturity.

The results of microfacies analysis also allow the character of the depositional environment to be defined, and the reconstruction of the mechanism of origin. In this field, the contribution of studies of sedimentary structures and textures (such as parallel or inclined lamination, positive gradation) is very important.

Only seven of WILSON's (1975) SMF were identified in the sections studied for this paper, all of which belong to five facies belts (the following description is based on Wilson's definitions and numbering):

SMF 1 – spiculite. A dark, organic rich, and argillaceous lime mudstone or wackestone, siliceous spiculitic calcisiltite. Spicules are usually oriented, generally siliceous monoaxons, commonly replaced by calcite.

SMF 2 – microbioclastic calcisiltite. This is a mixture of fine bioclasts and peloids with a very fine grainstone or packstone texture. Fine ripple cross-lamination is common.

SMF 3 – pelagic lime mudstone. Its micrite matrix contains scattered fine sand or silt grains composed of pelagic microfossils (e. g. radiolarians or globigerinids) or megafauna such as graptolites or thin-walled bivalves.

SMF 5 – bioclastic grainstone or packstone. This is a common reef flank facies composed mainly of organic debris from organisms inhabiting the reef top and flanks. Geopetal fillings and umbrella effects from infiltered finer sediment are common.

SMF 9 – bioclastic wackestone or bioclastic micrite. Almost invariably this sediment contains the fragments of diverse organisms jumbled and homogenized by burrowing. It is formed in quiet water below the normal wave base, and contains preserved infauna and epifauna.

SMF 11 – coated bioclasts in sparite, grainstones. Bioclasts may be micritized. This sediment forms in areas of constant wave action, at or above the wave base so that lime mud is removed.

SMF 12 – coquina, bioclastic grainstone or rudstone, shell