NE-plunging mineral lineation L_2. Related intra-foliation rootless F_2 folds can be observed in the western and central parts of the dome, and flat-lying tight F_2 folds of decimetre-scale can be observed at its eastern margin. The character of D_3 phase is more heterogeneous, and is related to the Late Carboniferous compression and transpression. The NW- or SE-dipping, rather steep S_3 cleavage, the F_3 folds and NE-plunging L_3 intersection as well as locally developed stretching lineation formed during this phase. The shape of the F_3 folds changes from angular open folds or crenulation cleavage at the eastern margin of the Desná Dome through relatively rounded open folds in the Jeseník amphibolite massif, up to ductile tight folds or new S_3 foliation along the contact with the Žulová pluton, where the F_3 folds are no more present.

The metamorphism can be interpreted as polyphase one. Schulmann and Gayer (1999) distinguished two main Variscan metamorphic events – M_2 and M_3, superimposed on the pre-Variscan M_1 metamorphic assemblage in basement lithologies. The earlier Variscan metamorphism M_2 is of Barrovian type and is present in the entire Desná Dome, whereas the M_3 event is of HT/LP type, related to the thermal influence of the Žulová pluton in the western part of the study area. In the east, the M_3 reaches greenschist-facies conditions. The isograds of M_2 run NE–SW, cross-cutting the lithological boundaries (Souček 1978). The metamorphic assemblages typical of the prograde part of metamorphic history are (from E to W): ab + ep + chl ± qtz ± act ± bt ± stilp ± ttn ± ilm ± cal ± leucoxene ± tourmaline, with relics of magmatic clinopyroxene in the chlorite zone; ab + bt + ep ± chl ± act ± qtz ±ttn ± ilm ± cal in the biotite zone; oligoclase + hbl +act + ep ± chl ± bt ± qtz ± ttn ± ilm ± ap ± cal in the garnet zone; oligoclase – andesine + hbl ± ep ± chl ± bt ± cpx ± qtz ± cal ± ttn ± ilm ± ap in the staurolite zone; and andesine–bytownite + hbl ± ep ± cpx ± qtz ± cal ± ttn ± ilm in the sillimanite zone.

Hornblende–plagioclase thermometry was applied to estimate the temperatures of metamorphism. The first metamorphic event M_2 in the staurolite zone reached the temperature of 620–660 °C. The second event M_3, which overprinted M_2 in the W, reached the temperature of 690–740 °C in the sillimanite zone. According to Souček (1978), the pressures did not exceed 5.5 kbar

The future research will be concentrated on computer-aided microstructural analysis of different rock types and on computer-aided quantification of F_3 fold shapes. The character of F_3 folding is clearly controlled by changing anisotropy of amphibolites, consequently depending on microstructural pattern developed during M_2 metamorphism. In addition, the shapes vary with thermal influence of M_3 metamorphism. The objective will be to find and quantify the dependence of fold shapes on temperature and microstructural mechanical anisotropy of metabasites.

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Eolian Accumulation and Erosional Forms in a Backshore Environment – Examples from the Baltic Shoreline

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Wind action has a great influence on clastic seashore morphology and the features of sediments deposited in this environment. It is, however, limited to a backshore with the exception of dunes. A backshore is a part of a beach bordered seaward by beach ridges and inland by a storm ridge adjacent to the line of dunes.

Forms discussed in this study were described from a present-day beach in the central part of the Polish Baltic Sea coast. The mean diameter of sand particles from the area (2.1 j) measured by means of a graphic method (Folk and Ward 1957) places them within the fine sand class (Wentworth 1922), and the value of standard deviation ($d_1 = 0.22$) indicates that they are well-sorted. In places, there may be found larger patches of gravel with textural features characteristic for this environment (grains are well sorted, well rounded, and of oblate shape). Obviously the effects of wind action are determined mainly by such factors as strength, duration and direction of the wind. The observations were carried out in the second part of July 1999. At sunny weather the local wind force at that time varied from 0 to 3° in the Beaufort wind scale, reaching 4° at the moments of the strongest gusts (Demel 1974). Its direction changed in a diurnal rhythm from westerly and northwesterly (sea breeze, during day) to easterly and southeasterly (land breeze, at night). Under these conditions, numerous small-scale, usually undurable forms were produced, the origin of which may be analysed in terms of erosional or accumulative wind action.

Eolian ripples were the most typical effects of the accumulative wind action in the study area. At gentle wind (1–2° in the Beaufort wind scale) forms with height of up to 10 mm and wavelength of 50 to ca. 120 mm were produced. The ripples had straight crests running approximately N–S and showing clear asymmetry, which indicated either westward or eastward direction of sand transportation depending on the prevailing wind direction. At slightly stronger wind, larger forms were observed, reaching 15 mm in height and of similar wavelength as described above. Typically, such ripples had bifurcating sinuous crests. At gentle to moderate wind (3–4° in the Beaufort scale), still bigger forms were generated, of distinctly different geometry. Their height was reaching 25–35 mm and the wavelength 150–170 mm. Their curved crests suggested that they were crescent-shaped ripples. The eddy azimuth indicated, depending on a situation, either eastward or westward wind direction.

"Grass traces on sand" were relatively common, though undurable structures present on the beach. The plants, with extensive root system anchoring them in the sand, had long springy leaves. Their leaves bent in the direction of the wind and, moved by its force, produced small arc-shaped grooves 2–3 mm deep.

Sand drifts and wind–related crescent marks belong to another group of structures often observed in the described area. The sand drifts are of purely accumulative origin and the wind-related crescent marks result from both accumulative and erosive (deflation) wind action. Despite the slightly different origin, these forms were analysed together because in some cases it was impossible to tell them apart. Sand drifts are usually prism-shaped forms elongated in accordance with the dominating wind direction. Their origin was directly linked with the presence of obstacles in the way of wind-transported sand. The obstacles were usually represented by individual clusters of plants, fragments of branches or trunks, big peat clasts, larger pebbles and, unfortunately, also different anthropogenic wastes, mainly plastic containers. Dimensions of the sand drifts were different: the biggest ones were up to 30–50 cm high and 2–6 m long, while the dimensions of the smallest ones were several centimetres and 10–20 cm, respectively. It must be emphasized that the most important factors influencing the parameters of the sand drifts were the dimensions and the shape of an obstacle as well as its orientation relative to the dominant wind direction and the strength and duration of the wind action.

Wind–related crescent marks are most often relatively small structures with dimensions in the order of several centimetres to 20 cm. Their origin, similarly to that of the sand drifts, is connected with the presence of obstacles in the way of the wind. The obstacles were usually small pebbles, peat clasts or plant fragments. The wind-related crescent marks are of characteristic structure. A small, U-shaped groove roughly parallel to the outlines of the obstacle usually developed on the up-wind side of these forms. The groove was the deepest and broadest directly before the obstacle (3 to 5 cm in the observed cases). Down-wind (i.e., behind the obstacle) it was getting shallower and finally disappeared at some distance. In some cases no groove at all was present on the up-wind side of the obstacle and a small erosional form generated by deflation was present down-wind. Rarely, an erosional structure was formed due to deflation up-wind and an accretion-related form (a small mound) down-wind, behind the obstacle. A large variety of such structures was recorded depending on the differences in the size and shape of an obstacle, its orientation in relation to the wind direction, the strength and duration of the wind action.

Deflation pavement horizons are other structures whose origin is at least partly connected with the erosive wind activity. Thin patches of gravel several meters wide were observed in the investigated area, stretching (with gaps) over hundreds of meters. These primary accretions may be called storm pavement horizons due to their considerable extent and small thickness. Under normal-weather conditions, these structures were subjected to eolian activity. This was confirmed by the presence of small eolian ripples, wind-related crescent marks and small sand-drifts in the vicinity of the accretions of pebbles. Selective erosive wind activity led to specific concentrations of gravel in a certain horizon (i.e., on the surface of beach sand), which – in the author's opinion – allows to refer to such mechanically reworked pebble horizons as a deflation pavement.

In some cases it was possible to observe the effects of the erosive wind activity connected with wind-transported sand (i.e., corrasion). The best examples of such forms were present in large peat clasts. Often a clearly defined cavity 8 to 12 cm high and up to 10 cm deep was developed on the level of the beach sand. Such cavities were best developed in the up-wind face of the clasts. They can be therefore interpreted as products of corrasion. The presence of the above mentioned clasts unequivocally precludes the possibility of the influence of sea waves on the formation of the cavities under normal-weather conditions.

In the author's opinion, the structures referred to as "sand mushrooms" had a very similar although more disputable origin. In the beach environment a layer of dry sand susceptible to the eolian treatment is of limited thickness. It is therefore possible that, at mild to moderate wind (3–4° in the Beaufort wind scale), the layer was completely removed by deflation and a horizon of wet sand cemented by cohesion forces was exposed. At a certain wind strength and under the influence of "pure" deflation the structure of the wet sand remained intact. Under the same conditions, however, the wet sand horizon might have been carved by corrasion forces producing "sand mushroom". The height of these structures in the observed cases was from 2–4 cm up to about 10 cm, their width and length varied from 8–12 cm to several dozens of centimetres. The forms were rounded, probably as a result of the fluctuations in the direction and strength of the wind during day.

The diversity and abundance of the forms related to either erosive or accumulative wind action show that the influence of the eolian factor on the modelling of the backshore environment could be significant. These forms were described from the present-day beach. It is highly probable that at least some of them may be preserved in the stratigraphical record in spite of the great dynamics of the environment (wind, waves). Other described structures, due to their short lifetimes, may be observed only on a present-day beach. Nevertheless, no matter whether recognized in the stratigraphic record or as they occur at present, the analysed forms can be employed as useful wind regime indicators in the analysed environment due to their characteristic morphological, textural and structural features.

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