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CONTACT KARST OF SOUTHERN VELEBIT (CROATIA)

KONTAKTNI KRAS JUŽNEGA VELEBITA (HRVAŠKA)

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Dražen Perica & Nenad Buzjak: Kontaktni kras južnega Velebita (Hrvaška)

Kraški relief je najbolj pogost tip reliefa na Velebitu. Ob stikih dobro prepustnih karbonatov s slabo ali celo neprepustnimi plastmi karbonske, permske ali triasne starosti, opažamo tipične kontaktne pojave. Na južnem Velebitu so značilni primeri kontaktnega krasa Oštarijsko polje, slepa dolina potoka Crno vrilo in dolina potoka Bunovca.
Ključne besede: kontaktni kras, fluviokras, ponor, Oštarijsko polje, Crno vrilo, Bunovac, Velebit, Hrvaška.

Abstract UDC: 551.44(497.5)

Dražen Perica & Nenad Buzjak: Contact karst of Southern Velebit (Croatia)

Due to the predominance of soluble and broken carbonate beds on Velebit Mt., karst is main relief type there. But there also contact karst or fluviokarst occurs. It is developed in the parts where the alternation of permeable carbonate and less permeable or impermeable Carboniferous, Permian and Triassic beds occurs. Most significant contact karst forms in the area of Southern Velebit are Oštarijsko polje, Crno vrilo creek blind valley and Bunovac valley.
Key words: contact karst, fluviokarst, ponor, Oštarijsko polje, Crno vrilo, Bunovac, Velebit Mt., Croatia.

INTRODUCTION

With the area of 2359 km^2 and the length of 145 km Velebit is the most important mountain in Croatia. It spreads in Dinaric or NW-SE direction.

Velebit is a part of Dinaric Mountains. In geotectonic sense it is the highest lifted part of Dinaric unit which is thrusted over the unit of Adriatic. Therefore the main structures in its constitution are reverse faults, folds and thrusts (Bahun 1974; Herak 1986; Prelogović 1975; Prelogović 1995). The domination of carbonate beds (limestones and less dolomites) in combination with other relevant factors, resulted in development of karst. Besides deep bare karst in thick carbonate beds, in some smaller areas contact karst or fluviokarst is also developed (Perica 2000).

CONTACT KARST OF VELEBIT MT.

The occurrence of contact karst on Velebit Mt. is, among other relevant factors, highly conditioned by hydrogeological characteristics of beds in the areas where it occurs. Since the most of the Velebit is developed in well permeable carbonate beds, meteoric water quickly sinks under-

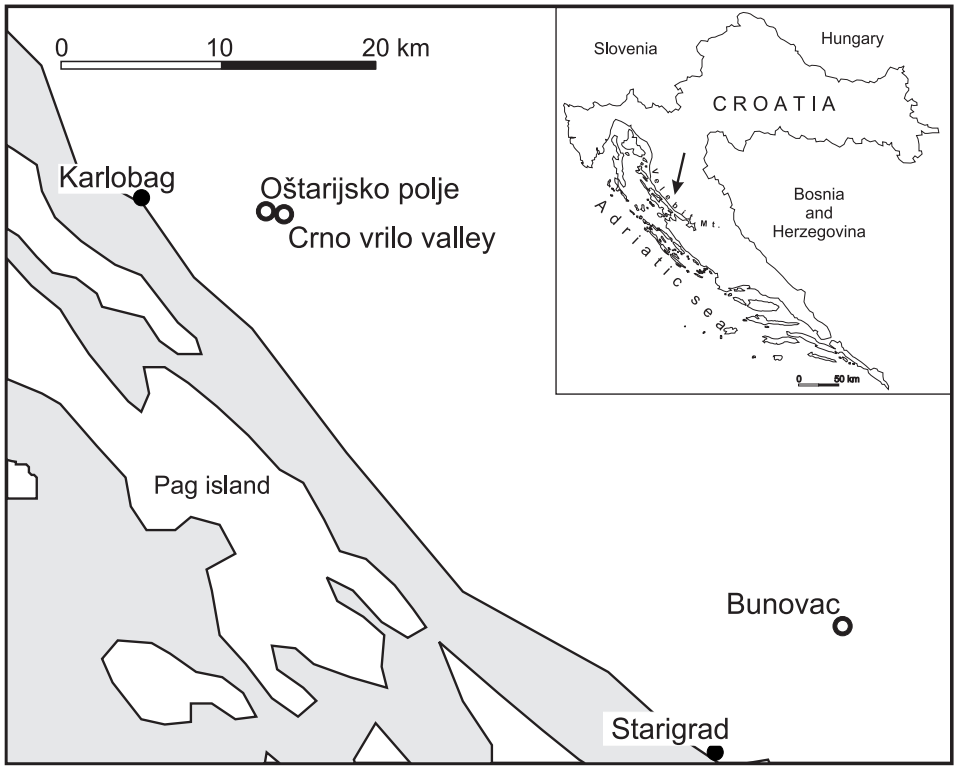

Fig. 1: Position map of research areas (N. Buzjak).

ground using the paths provided by numerous fissures. Therefore surface water (springs and streams) is very rare there. Its occurrence is conditioned by the contacts of permeable (limestones) and partially permeable beds (dolomites, areas of alternation of limestones and Tertiary Jelar breccias) with impermeable beds (Carboniferous and Triassic clastites and Permian beds). The karst springs are rare, mostly periodically and of small discharge.

Besides hydrogeological conditions slope inclination has a big importance in contact karst development. The rise of inclination resulting in higher surface run-off coefficient that decreases corrosion and increases slope washing (Perica 2000).

In the areas of contact karst main relief forms are blind valleys, dry valleys, hanging valleys, canyons, karst poljes and fragments of karst plains (Perica 2000). In the area of Southern Velebit there were three contact karst forms studied: Oštarijsko polje, Crno vrilo creek blind valley and Bunovac valley (Fig. 1).

OŠTARIJSKO POLJE

The depression of Oštarijsko karst polje is a morphological border between Middle and Southern Velebit (Fig. 2 and 3). Its development was predisposed by Brušani fault of WNW-ESE direction that passes by the northern border of polje and by Oštarije fault of E-W direction on the southern part (Fig. 4). Since Brušani fault cuts through the basic monocline structure of Velebit right here, zonal distribution of lithostratigraphic elements is disturbed by horizontal movements and by folding along Brušani-Oštarije anticline. It is supposed that the anticline's crest is therefore broken which enabled development of the polje's depression by selective denudation (mechanical weathering, slope processes, corrosion and fluvial erosion). Along Brušani fault at the eastern part of polje at the surface impermeable and partially permeable Carboniferous, Permian and Triassic beds occurs (clastites and dolomites; Sokač et al. 1974; Sokač et al. 1976a). Water that springs there forms the stream of Ljubica creek. It flows towards lower western part of polje. When it reaches by tectonic movements broken partially permeable Middle Triassic beds (Anisian

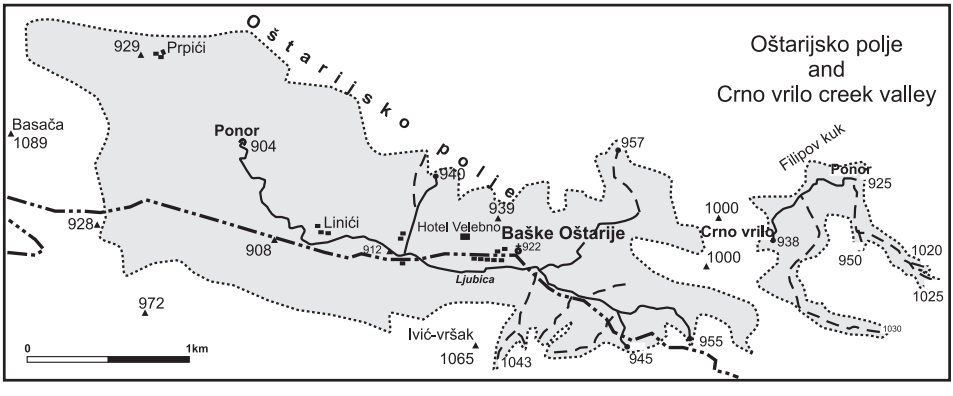

Fig. 2: Stream network with springs and ponors on Oštarijsko polje and Crno vrilo valley (N. Buzjak).

Fig. 3: Oštarijsko polje (D. Perica).

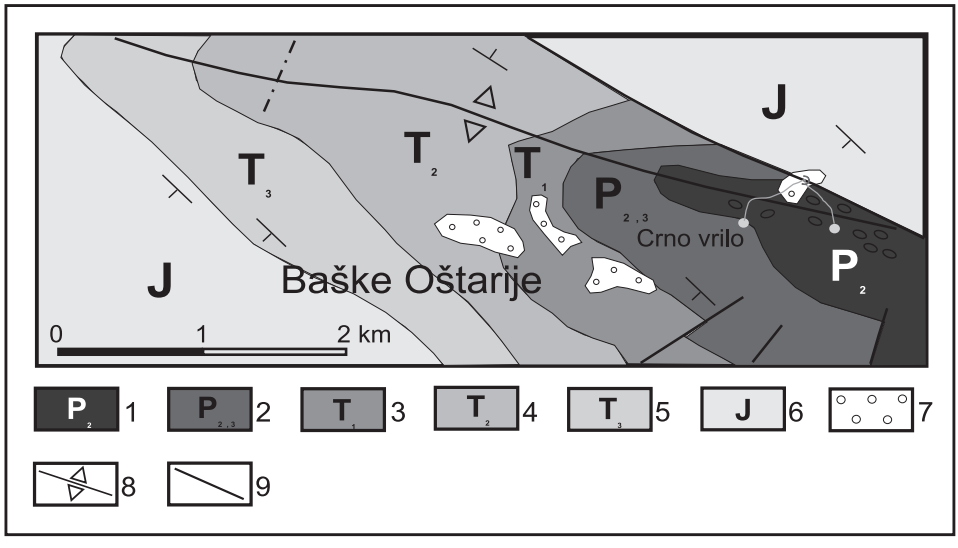

Fig. 4: Geological map of Oštarijsko polje and Crno vrilo valley (Sokač et al. 1974).
Legend: 1 - Middle Permian sandstones and quartz conglomerates, 2 - Middle and Upper Permian dolomites, 3 - Lower Triassic dolomite, sandstone and slate, 4 - Middle Triassic dolomites, 5 - Upper Triassic dolomites, 6 - Lower Jurassic beds, 7 - alluvium (Quaterary), 8 - anticline, 9 - major fault.

limestone and dolomite) it slowly sinks in 5 sieve-like ponors. The western part is built of permeable and partially permeable Lower Jurassic beds (Lias limestone and dolomite).

Depression of Oštarijsko polje generally has E-W direction. It is 3,75 km long and from 250 m (in eastern part) up to 2 km (in western part) wide. The bottom elevation in the western part is 900 m. The highest altitude is in the northern part in the area of Stupačinovo (980 m) that has the form of a bend. The movements along reverse fault of E-W direction probably condition its height and form. There was the area of the strongest bending of Brušani-Oštarije anticline and uplifting of Linić vršak block. There the anticline was broken along fault of N-S direction. Along this transverse fault Ljubica creek ponors occur.

Higher eastern and northern parts of polje's bottom are covered by residuum, material washed from surrounding slopes and alluvial deposits. They are the thickest in Ljubica creek valley. Its deposition was most intensive during the Pleistocene glaciation due to the intensive rock mechanical weathering. In the Ljubica creek ponor zone during the wet season in the colder part of the year and snow melting in spring there is often a small lake. It exists due to the partial permeability of the beds and choking of fissures by alluvial deposit. The western part of the polje is developed in Lower Jurassic beds (Lias limestone and dolomite) whose dolines show that karstification is the predominant morphological process there.

Since Oštarijsko polje is developed at the contact of permeable and partially permeable and impermeable beds it could be classified as a border polje (Gams 1974; Ford & Williams 1994; Perica 2000).

CRNO VRILO CREEK BLIND VALLEY

Crno vrilo creek blind valley is located 500 m east from Oštarijsko polje (Fig. 2). The creek springs in the area build of Permian sandstone (Fig. 4; Sokač et al. 1974; Sokač et al. 1976a). The main spring is at elevation of 938 m. Flowing over Permian quartz conglomerates beds it formed a 800 m long fluvial valley. At the Brušani fault where impermeable Permian beds are in contact with permeable and karstified Middle Jurassic beds (Dogger limestone) today's main ponor was developed (Fig. 5). The ponor is an 81 m deep pit system with two entrances (Garašić 1981).

About 450 m downstream from the spring the stream deposited a small alluvial plain that partially filled the older ponors. Their remains are still observable at the slopes of the valley. Today there are only some sieve-like ponors periodically active only during higher water in the spring.

BUNOVAC VALLEY

A specific feature of Velebit contact karst is Bunovac valley (or Bunjevac) located at the northeastern slope of southern Velebit (Fig. 6). It consists of two alluvial valleys: the northwestern that is larger and semi-dry and the southern, the shorter one. They were formed at the contact of impermeable Upper Triassic clastites and partially permeable Middle Triassic beds (Ladinian limestones and dolomites; Fig. 7 and 8; Šušnjar et al. 1973; Sokač et al. 1976b). The creek that flows towards the eastern part of Bunovac valley sinks at its beginning. The flat bottom there is

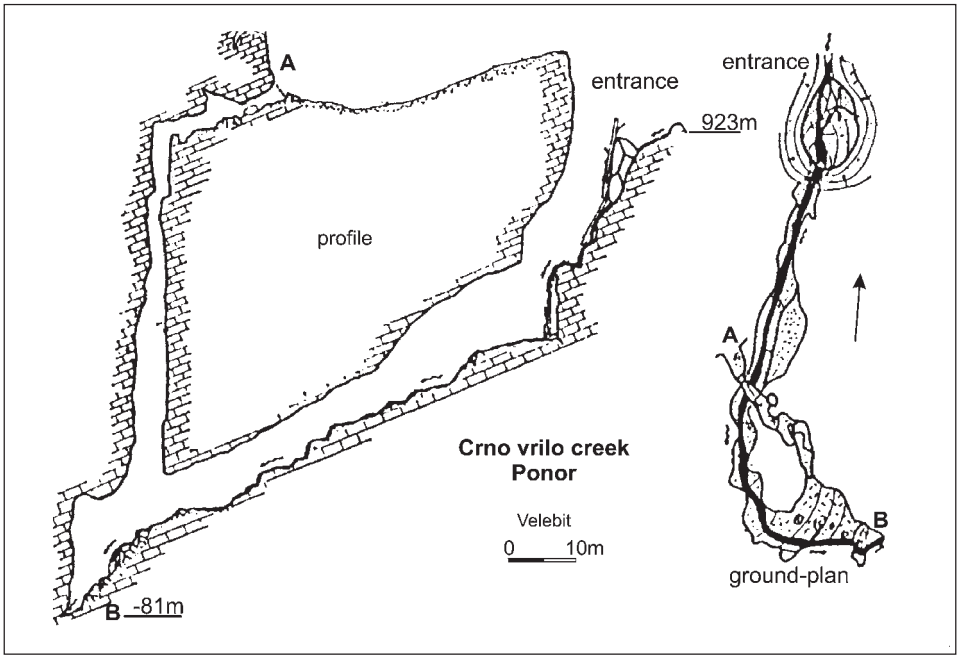

Fig. 5: The plan of Crno vrilo creek ponor (Garašić 1981).

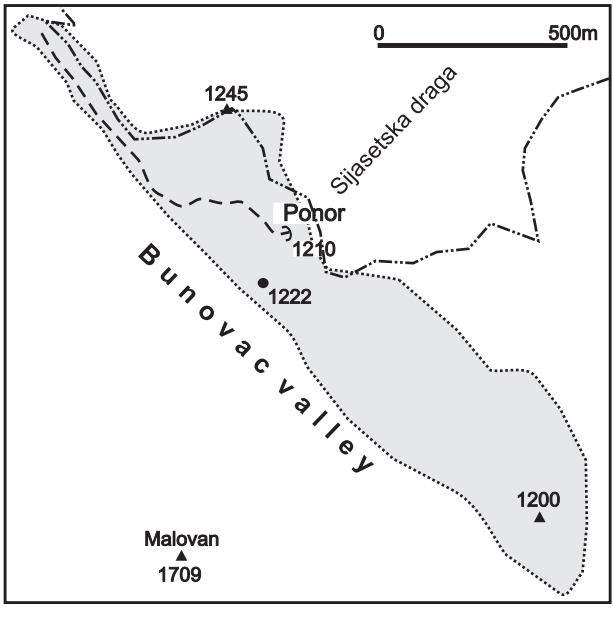

Fig. 6: Bunovac valley (N. Buzjak).

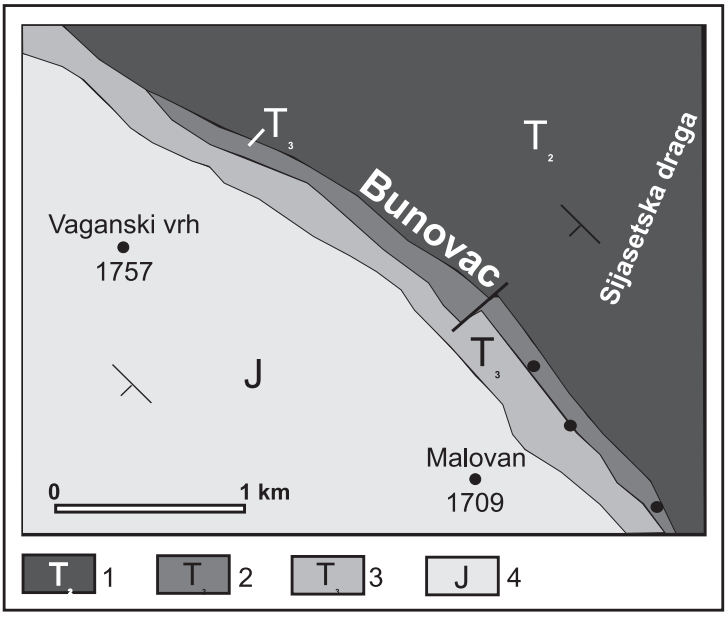

Fig. 7: Geological map of Bunovac area (Šušnjar et al. 1973).
Legend:
1-Middle Triassic limestones and dolomites,
2-Upper Triassic conglomerates and clastites,
3-Upper Triassic limestones and dolomites,
4-Jurrasic limestones and dolomites
(N. Buzjak).

Fig. 8: The outcrop of Upper Triassic clastites in Bunovac valley with debris produced by mechanical weathering and washed by water (D. Perica).

rich in small dolines and alluvial deposits that indicate its hydrological activity in the past. At the western part the valley was formed by activity of two short creeks. The bottom is covered by alluvial material. Streams are sinking at its southeastern part. In the past their water flowed towards northeast throw Sijasetska draga valley. By cutting of the creek bed the blind valley was formed. Since these valleys are about 1500 m long and up to 300 m wide, it can be considered as transitional phase towards karst polje.

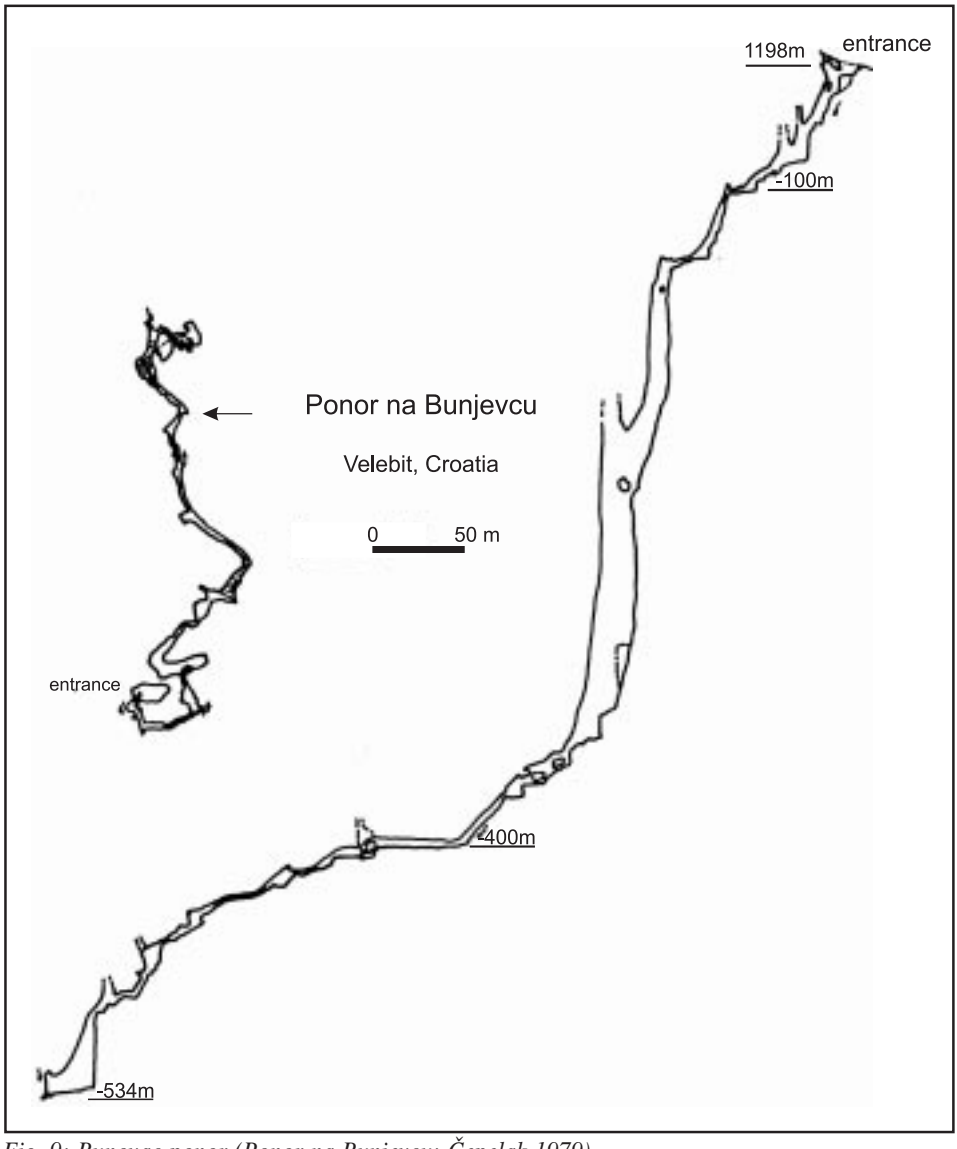

Fig. 9: Bunovac ponor (Ponor na Bunjevcu; Čepelak 1979).

The largest among ponors is Bunovac ponor (Ponor na Bunjevcu; Čepelak 1979; Garašić 1986). That is a 534 m deep pit (Fig. 9). It has three morphological parts predisposed by different lithological units. The first part (to the depth of -105 m) developed in less permeable Upper Triassic dolomite is characterized by alternation of smaller vertical passages with narrow horizontal parts. The second one to -350 m is in Middle Triassic dolomites with deep and wide vertical passages. The deepest part is formed in Lower Triassic limestones and dolomites with narrower and more horizontal passages.

CONCLUSION

The development and characteristics of contact karst areas on southern part of Velebit Mt. is determined by local lithological, hydrogeological and hydrological conditions, tectonic structure, and paleo- and recent climate. These factors controlled and directed morphological processes at the surface and partially underground. One of the important factors was water in the form of ice, snow, rain or surface and underground streams that caused mechanical weathering, slope washing, corrosion and accumulation (mostly in depressions). Due to the predomination of highly karstified beds surface water is very rare there. Its occurrence is conditioned by the contacts of impermeable beds (Carboniferous, Permian and Triassic clastites) with partially permeable (dolomites) and permeable beds (limestones). Besides the above-mentioned factors slope inclination has a big importance in contact karst development. The rise of inclination resulting in higher surface run-off coefficient that decreases corrosion and increases slope washing.

Such processes were observed and recorded in cases of Oštarijsko polje, Crno vrilo blind valley and Bunovac valley. The surface morphological processes (and partially karst process) formed all these forms at the contact between the beds of different permeability. Acting as surface water collectors, due to the impermeable base and cover, they also influenced the underground water circulation. That is clearly observable in the cases of old and still active ponors formed at the contact with more permeable beds.

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KONTAKTNI KRAS JUŽNEGA VELEBITA (HRVAŠKA)

Povzetek

Pogorje Velebita je del Dinaridov. Razteza se na dolžini 145 km v Dinarski smeri (NW-SE). Večji del pogorja sestavljajo tektonsko pretrti karbonati, zato je kras najbolj tipičen tip pokrajine. Razvoj kontaktnega krasa na južnem Velebitu pogojujejo specifični litološki, hidrogeološki in hidrološki pogoji ter tektonska struktura in klima. Kontaktni pojavi so ob stikih dobro prepustnih karbonatov s slabo ali celo neprepustnimi plastmi karbonske, permske ali triasne starosti. Pomemben faktor razvoja kontaktnega krasa je mehansko in kemično delovanje vode, snega in ledu.

Tipične oblike kontaktnega krasa so slepe, suhe in viseče doline, kanjoni, polja in deli kraških ravnikov. Najbolj značilni primeri kontaktnega kras so Oštarijsko polje, slepa dolina potoka Crno vrilo in dolina potoka Bonovac na južnem Velebitu.