

# Simplified structural map of Kras Kras (Slovene), Carso (Italian) = Geographical unit

## Poenostavljena strukturno-geološka karta Krasa Kras (slovensko), Carso (italjansko) = geografska enota

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*Ključne besede:* Kras, tektonika, tektonska geomorfologija, Slovenija

### Abstract

With this contribution comes a printed copy of the *Simplified structural map of Kras*, comprising an area on both sides of the state border between Slovenia and Italy, as well as its short description. The map conveys updated information on faults and newly discovered geomorphologically indicated joint-fault zones in the area.

### Izvelek

Prispevek prinaša natis *Poenostavljene strukturno-geološke karte Krasa*, ki zajema ozemlje na slovenski in italijanski strani državne meje ter kratek opis. Karta vsebuje dopolnjene podatke o poteku prelomov in o novoodkritih geomorfološko izraženih razpoklinsko-prelomnih conah.

In this issue of *Geologija*, the *Simplified structural map of Kras* is published in order to provide some information about the progress of research conducted in the Kras region (Classical Karst Region – Kras). The map has been compiled as an essential appendix of a more extensive work, *Geomorphology of Kras*, which is being prepared in co-authorship by L. Placer and A. Mihevc.

In the Slovenian part, the map is based on works published by JURKOVŠEK et al. (1996), JURKOVŠEK (2010, 2013) and PLACER (2005, 2007), and in the Italian part on those by CUCCHI & PIANO (2013), CUCCHI et al. (2015) and RIŽNAR (2014). Moreover, data gathered during sea bottom research of the Gulf of Trieste (BUSETTI et al., 2010; CARULLI, 2011) are also included. The interpretation of structure is based on the before mentioned works and on the reconnaissance structural profiling of the entire area of the map, made in 2010 to 2013.

The interpretation of structure and geomorphology of the Kras region was based on the findings published in a paper entitled *The bases for understanding of the NW Dinarides and*

*Istria Peninsula tectonics* (PLACER et al., 2010). By applying the mentioned maps, recent structural profiling and study of remote sensing data, we identified several kinematic phases that reflect in the geological structure and geomorphology of the surface. Most of the faults underwent one or more reactivations in various directions, and therefore were not marked by map symbols of movement directions of their fault blocks. Some symbols appear only on the most important faults of the Istria-Friuli Underthrust Zone, which is the most stable in this sense. Interestingly, among the more important newly established features there are three geomorphologically active joint-fault zones within which structural escarpment have developed. The first one is the *Doberdo (Doberdob) joint-fault zone* along which the larger part of Vallone di Doberdo (Doberdovski dol) has formed, and the *Opajsko selo structural escarpment*, that separates the peneplains of the Kostanjevica and Doberdo (Doberdob) Kras. The latter subsided along the joint-fault zone for 60 to 70 m. The second one is the *Sežana joint-fault zone* with the *Lipica structural escarpment*, along which the west block has subsided for about 15 to 20 m. The third one is the *Matavun joint-fault zone* with the *Škocjan structural escarpment*, along

which the eastern block has subsided. Systems of fissures in various directions, predominately north-south, are quite abundant on the Kras plateau, but hitherto they have been considered mostly in connection with the processes leading to the formation of dolines, caves and sinkholes.

Among the plicative deformations, larger and smaller ones have been distinguished. I would like to emphasize the larger ones located on the borders between the Trieste-Komen anticlinorium and the Čičarija anticlinorium (after BUSER 1976, Čičarija anticline) and the Brkini synclinorium (after BUSER 1976, Reka synclinorium) respectively, and the ones between the Vipava synclinorium and the Ravnik anticlinorium (after PLACER 2005, Ravnik anticline). On previous maps some of these were not depicted as folds; they are, however, very important for the understanding of structure and geomorphology.

The *Geomorphology of Kras* is conceived as an extended guidebook to the *Simplified structural map of Kras*. It comprises a discussion on the influence of the Istria Pushed Area on the postorogenic evolution of the External Dinarides and their geomorphology. From this basis follows a schematic morphotectonic subdivision of the Dinaric Karst in the area of the External Dinarides, and a concept of morphogenetic evolution of the area of Classical Karst (between the Gulf of Trieste and Ljubljansko barje / the Ljubljana Marsh) with Istria Peninsula and Kras. The latter is considered in detail. The evolution of morphology is presented in terms of synergistic effects of lithostratigraphy, structure, exogenic processes and tectonics. In the frame of the latter, we attempted to provide some answers to the complex question of causes that lead to the formation of the Istria Pushed Area.

#### **Poenostavljena strukturno-geološka karta Krasa Kras (slovensko), Carso (italjansko) = geografska enota**

V tej številki Geologije je objavljena *Poenostavljena strukturno-geološka karta Krasa*, kar predstavlja prispevek k obveščanju o poteku raziskav na Krasu. Izdelana je kot osnovna priloga obsežnejšega dela *Geomorfologija Krasa*, ki se pripravlja v soavtorstvu L. Placerja in A. Mihevca.

Na območju Slovenije je karta sestavljena iz del, ki so jih objavili JURKOVŠEK et al. (1996), JURKOVŠEK (2010, 2013) in PLACER (2005, 2007), na območju Italije pa CUCCHI & PIANO (2013), CUCCHI et al., (2015) in RIŽNAR (2014). Poleg tega so zajeti tudi podatki raziskav morskega dna Tržaškega zaliva (BUSETTI et al., 2010; CARULLI, 2011). Interpretacija strukture sloni na omenjenih delih in na preglednem strukturnem profiliranju, ki je bilo opravljeno na celotnem ozemlju v letih 2010-2013.

Raziskovanje strukture in geomorfologije Krasa je bilo zasnovano na ugotovitvah razprave *The bases for understanding of the NW Dinarides and Istria Peninsula tectonics = Osnove razumevanja tektonske zgradbe NW Dinaridov in polotoka Istre* (PLACER et al., 2010). Na podlagi podatkov zgoraj omenjenih kart, novega strukturnega profiliranja in proučevanja daljinskih posnetkov, je bilo mogoče določiti več kinematskih faz, ki se odražajo v geološki zgradbi in geomorfologiji površja. Prelomi so večinoma doživeli eno ali več reaktivacij v različnih smereh, zato nimajo oznak, ki bi nakazovale smer premika prelomnih kril. Te so zabeležene le pri najpomembnejših prelomih Istrsko-furlanske podrivne cone, ki so v tem smislu najbolj stabilni. Od pomembnejših novosti so zanimive tri geomorfološko tvorne razpoklinsko-prelomne cone, znotraj katerih so se razvili strukturni pragovi; prva je *doberdobska razpoklinsko-prelomna cona* po kateri je nastal večji del Doberdobskega dola in *opajski strukturni prag*, ki loči uravnani Kostanjeviškega in Doberdobskega Krasa. Slednja je ob njej ugreznjena okoli 60 do 70 m. Druga je *sežanska razpoklinsko-prelomna cona z lipiškim strukturnim pragom* ob katerem je zahodno krilo ugreznjeno okoli 15 do 20 m. Tretja je *matavunska razpoklinsko-prelomna cona s škocjanskim strukturnim pragom* ob katerem pa je ugreznjeno vzhodno krilo. Snopi razpok v različnih smereh, posebno v smeri sever-jug, so na Krasu številni, toda doslej smo menili, da so pomembni predvsem za nastajanje vrtač, jamskih objektov in udornic.

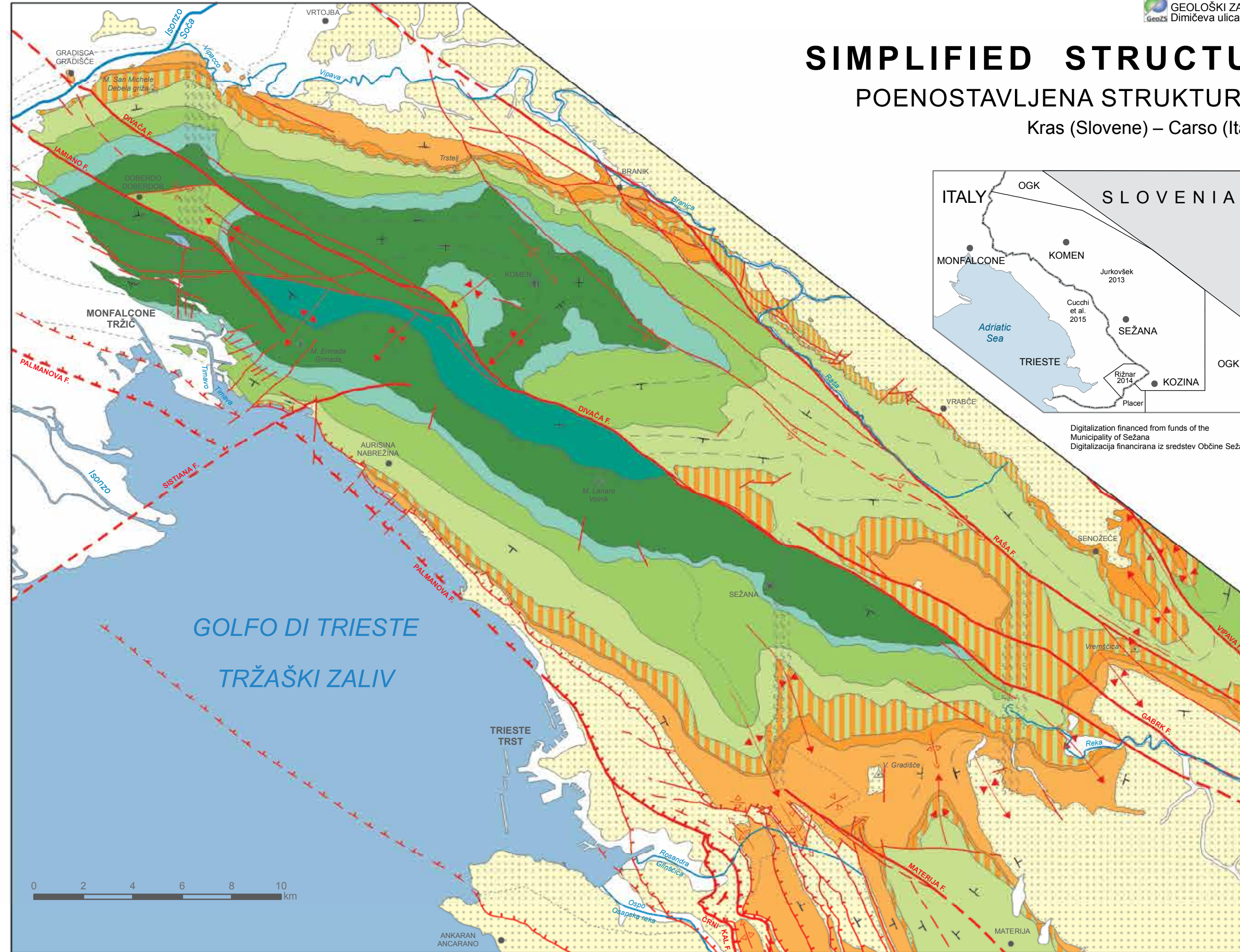
Plikativne deformacije so ločene na večje in manjše. Opozoril bi na večje na mejah Tržaško-komenskega antiklinorija s Čičarijskim antiklinorijem (po BUSERJU 1976, Čičarijska antiklinala) in Brkinskim sinklinorijem (po BUSERJU 1976, Reški sinklinorij) ter med Vipavskim sinklinorijem in Ravniškim antiklinorijem (po PLACERJU 2005, Ravniška antiklinala), od katerih nekatere na dosedanjih kartah niso bile prikazovane kot gube, vendar imajo za razumevanje strukture in geomorfologije velik pomen.

Geomorfologija Krasa je zasnovana kot razširjeni tolmač Poenostavljene strukturno-geološke karte Krasa. V njej bo tekla razprava o vplivu Istrskega potisnega območja na postorogeni razvoj Zunanjih Dinaridov in njihovo geomorfologijo. Iz tega bo izveden pogled na morfotektonsko rajonizacijo dinarskega krasa na prostoru Zunanjih Dinaridov ter pogled na morfogenetski razvoj ozemlja klasičnega krasa (med Tržaškim zalivom in Ljubljanskim barjem) z Istro in na Krasu. Slednji bo obdelan podrobneje. Razvoj reliefa bo prikazan kot sinergija litostratigrafije, strukture, eksogenih procesov in tektonike. V okviru slednje bomo skušali odgovoriti na kompleksno vprašanje vzrokov, ki so pripeljali do nastanka Istrskega potisnega območja.

# SIMPLIFIED STRUCTURAL MAP OF KRAS

## POENOSTAVLJENA STRUKTURNO-GEOLOŠKA KARTA KRASA

Kras (Slovene) – Carso (Italian) = Geographical unit



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Geological data after / Geološki podatki po:

**Jurkovšek, B. et al. 1996:** Formacijska geološka karta južnega dela Tržaško-komenske planote 1:50.000 = Geological Map of the Southern Part of the Trieste-Komen Plateau 1:50.000. Inštitut za geologijo, geotehniko in geofiziko, Ljubljana.  
**Jurkovšek, B. 2008:** Geološka karta severnega dela Tržaško-komenske planote 1:25.000 = Geological Map of the Northern Part of the Trieste-Komen Plateau. Geološki zavod Slovenije, Ljubljana.  
**Jurkovšek, B. 2013:** Geološka karta Krasa v Geologiji Krasa = Geological Map of Kras (Slovenia) in Geology of Kras. Geološki zavod Slovenije, Ljubljana.  
**Cucchi, F. et al. (curated by) 2015:** Carta Geologica del Carso Classico = Geološka karta Klasičnega Krasa. Progetto/Projekt HYDROKARST. Università di Trieste.  
**OGK:** Osnovna geološka karta SFJ 1:100.000, listi Gorica, Trst, Postojna, Ilirska Bistrica = Basic Geological Map of Yugoslavia 1:100.000, sheets Gorica (Gorizia), Trst (Trieste), Postojna, Ilirska Bistrica. Savezni geološki zavod, Beograd.  
**Placer, L. L.:** Field notes = Terenski zapisi. **Rižnar, I. 2014:** The flysch/carbonates junction in the S. Dorigo delle Valle / Dolina Municipality. **Busetti et al. 2010:** Meso-Cenozoic seismic stratigraphy and the tectonic setting of the Gulf of Trieste (northern Adriatic). **Carulli, G. B. 2011:** Structural model of the Trieste Gulf. A proposal.

Structure supplemented and edited by / Strukturno dopolnil in uskladi: **Ladislav PLACER**

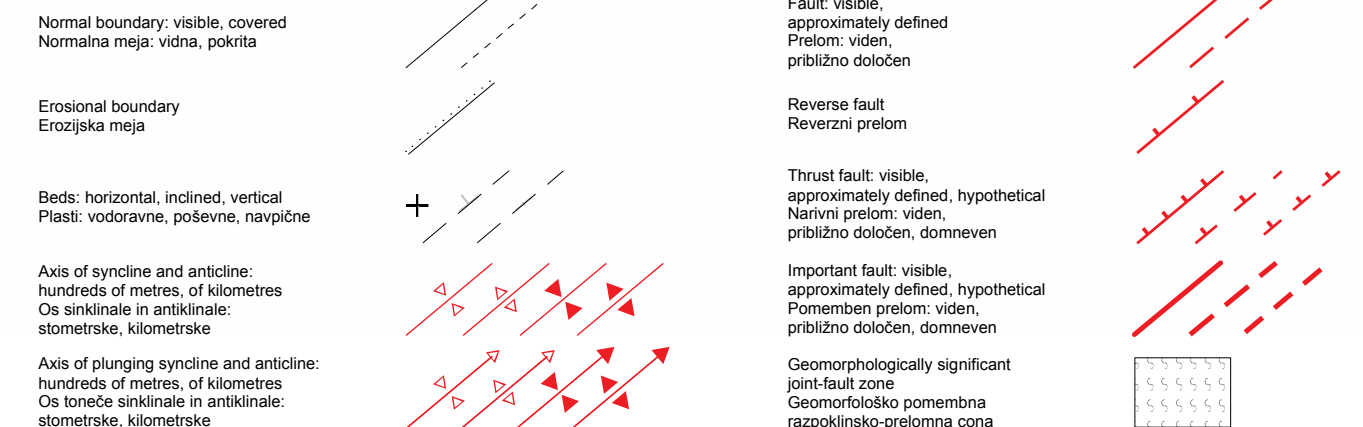
STRATIGRAPHIC CHART after / STRATIGRAFSKA TABELA po:  
Jurkovšek, B. et al. 2013

		AGE STAROST	FORMATION FORMACIJA	MAP KARTA
<b>QUATERNARY KVARTAR</b>			KV	
<b>TERTIARY - TERCIAR</b>	<b>PALEOGENE</b>	EOCENE EOCEN	F, PP	
		PALEOCENE PALEOCEN	ANA, TF, TF1, TF2	KRASKA GRUPA
	<b>UPPER CRETACEOUS ZGORNJA KREDA</b>	MAASTRICHTIAN MAASTRICHTIJ	LIB	
		CAMPANIAN CAMPANIJ	LF	
<b>LOWER CRETACEOUS SPODNJA KREDA</b>	TURONIAN TURONIJ	RF		
	CENOMANIAN CENOMANIJ	PF		
		ALBIAN ALBIJ	BF	
		APTIAN APTIJ		
		VALANGINIAN VALANGINIJ		

DESCRIPTION OF FORMATIONS after / OPIS FORMACIJI po: Jurkovšek, B. 2008

**KV:** Quaternary deposit  
Kvartarni nanos  
**F:** FLYSCH. Alternation of marlstone, sandstone, breccia and conglomerate. Calcarentic intercalations and olistostromes. In the basis Transitional Beds (PP): breccia and basal marl FLIS. Menjavanje laporovca, peščenjaka, breče in konglomerata. Vložki kalkarenita in olistostrome. V podlagi prehodne plasti (PP): breča in bazalni lapor  
**ANA:** ALVEOLINID-NUMMULITID LIMESTONE. Bedded and massive limestone  
ALVEOLINSKO-NUMMULITNI APNENEC. Plastnati in masivni apnenec  
**TF:** TRSTELJ FORMATION. Upper Trstelj Beds (TF2): Bedded calcarenite with foraminifers. Lower Trstelj Beds (TF1): Bedded, mainly miliolid limestone  
TRSTELJSKA FORMACIJA. Zgornje trsteljske plasti (TF2): Plastnati kalkarenit s foraminiferami. Spodnje trsteljske plasti (TF1): Plastnati, pretežno miliolidni apnenec  
**LIB:** LIBURNIA FORMATION. Bedded limestone, marly limestone and limestone breccia  
LIBURNIJSKA FORMACIJA. Plastnati apnenec, laporasti apnenec in apnenčeva breča  
**LF:** LIPICA FORMATION. Bedded and massive limestone with rudist biostromes and bioherms. Intercalations of platy and laminated Tomaj Limestone with chert  
LIPIŠKA FORMACIJA. Plastnati in masivni apnenec z rudistnimi biostromami in biohermami. Vmes ploščasti in laminirani tomajski apnenec z rožencem  
**SF:** SEŽANA FORMATION. Bedded limestone with rare rudist biostromes. Intercalations of bedded Pliskovica Limestone with chert and with pelagic microfossils and platy laminated Komen Limestone with chert. In the basis bedded limestone with oncoids and desiccation pores and thickly bedded to massive limestone with large amount of rudists  
SEŽANSKA FORMACIJA. Plastnati apnenec z redkimi rudistnimi biostromami. Vmes plastnati pliskovski apnenec z rožencem in pelagičnimi mikrofosili ter ploščasti in laminirani komenski apnenec z rožencem. V podlagi plastnati apnenec z onkoidi in izsušitvenimi porami ter debeleplastnati do masivni apnenec z veliko količino rudistov  
**RF:** REPEN FORMATION. Bedded limestone with chert and pelagic microfossils.  
Intercalations of platy and laminated Komen Limestone with chert and pelagic microfossils. In the basis massive, partly recrystallized Kopriva Limestone with displaced, locally broken and rounded rudist shells  
REPENSKA FORMACIJA. Plastnati apnenec z rožencem in pelagičnimi mikrofosili. Vmes ploščasti in laminirani komenski apnenec z rožencem in pelagičnimi mikrofosili. V podlagi masivni in delno rekristalizirani koprivski apnenec s premeščenimi, mestoma zdrobljenimi in zaobljenimi lupinami rudistov  
**PF:** POVIR FORMATION. Bedded, locally platy limestone with thicker dolomite intercalations and with rare intercalations of dolomitic breccia and limestone breccia. In upper part platy and laminated Komen Limestone with chert. In the basis emergence breccia  
POVIRSKA FORMACIJA. Plastnati, lokalno ploščasti apnenec z debelejšimi vložki dolomita in redkimi vložki dolomitne breče ter apnenčeve breče. V zgornjem delu ploščasti in laminirani komenski apnenec z rožencem. V podlagi emerzijska breča  
**BF:** BRJE FORMATION. Bedded limestone and dolomite with intercalations of dolomitic breccia and limestone breccia  
BRŠKA FORMACIJA. Plastnati apnenec in dolomit z vložki dolomitne in apnenčeve breče

LEGEND OF SYMBOLS / LEGENDA ZNAKOV





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