

ACTA CARSOLOGICA	30/2	10	157-164	LJUBLJANA 2001
------------------	------	----	---------	----------------

COBISS: 1.08

**CONTACT CAVES IN FLYSCH FORMATIONS -  
FRIULI REGION - NORTHEAST ITALY**

**KONTAKTNE JAME V FLIŠNIH FORMACIJAH FURLANIJE**

**ANDREA MOCCHIUTTI<sup>1</sup>**

<sup>1</sup> Circolo Speleologico e Idrologico Friulano, via Beato Odorico da Pordenone 3, IT-33100 UDINE, ITALIA

Prejeto / received: 30. 8. 2001

**Izvleček**

UDK: 552.54(450)

**Andrea Mocchiutti: Kontaktne jame v flišnih formacijah Furlanije**

Največ jam na območju Monte Bernadie in doline Nadiže (severovzhodna Italija) je razvitih ob kontaktu apnenca in laporja v flišni formaciji. Med njimi je več takih, ki so dolge preko kilometra, najdaljša pa meri 7 km. Tipični so rovi trapezne oblike, z ravnimi apnenčastimi stropi. Speleogeneza se začne s korozivnim razvojem inicialnih kanalov v apnencu, ki mu sledi erozijski razvoj rova v spodaj ležečo plast laporja ali peščenjaka.

**Ključne besede:** kontaktni kras, fliš, speleogeneza, Furlanija, Italija.

**Abstract**

UDC: 552.54(450)

**Andrea Mocchiutti: Contact caves in flysch formations - Friuli Region - northeast Italy**

Most of the discovered caves inside Bernadia mountains and Natisone Valley (northeast Italy) are positioned inside flysch formations at the limestone-marl contact. The longest contact cave in this area reach up to 7 kilometers, but several caves are more then one. The karstic flowpattern begins at the limestone marl contact, but rooms usually develop rapidly throughout a process called "erosion - dissolution" inside marl and sandstone beds, the limestone strata constitutes the compact and massive ceiling of the cave. Several examples are reported, with pictures and geological cross sections.

**Key words:** Contact karst, flysch, speleogenesis, Friuli, Italy.

## INTRODUCTION

In the north-east area of the Italian Alps, there is a wide presence of flysch formations. The major purpose of this study in progress is to understand, through the study of cave morphologies and lithology the evolution of contact caves. Observations are specially related to two zones near Lusevera and Cividale (Udine). They are concerned with geological stratigraphic and structural conditions. The caves studied from this point of view are ten, while observations about morphology have been made in other caves also. The data considered point out the particular stratigraphic situation which is present in the area. Consequently the morphologies pointed out and the objective data collected appear to be fundamental for the comprehension of the evolution of these contact karst systems of the region.

What makes possible the development of contact caves in this area is the presence of calcarenite beds of about 10 to 30 meters thick inside marl and grainstone strata. About 70% of horizontal caves in this flysch area is constituted of spring caves at the contact limestone - marl, where marl strata is the semi-permeable table for waterflow.

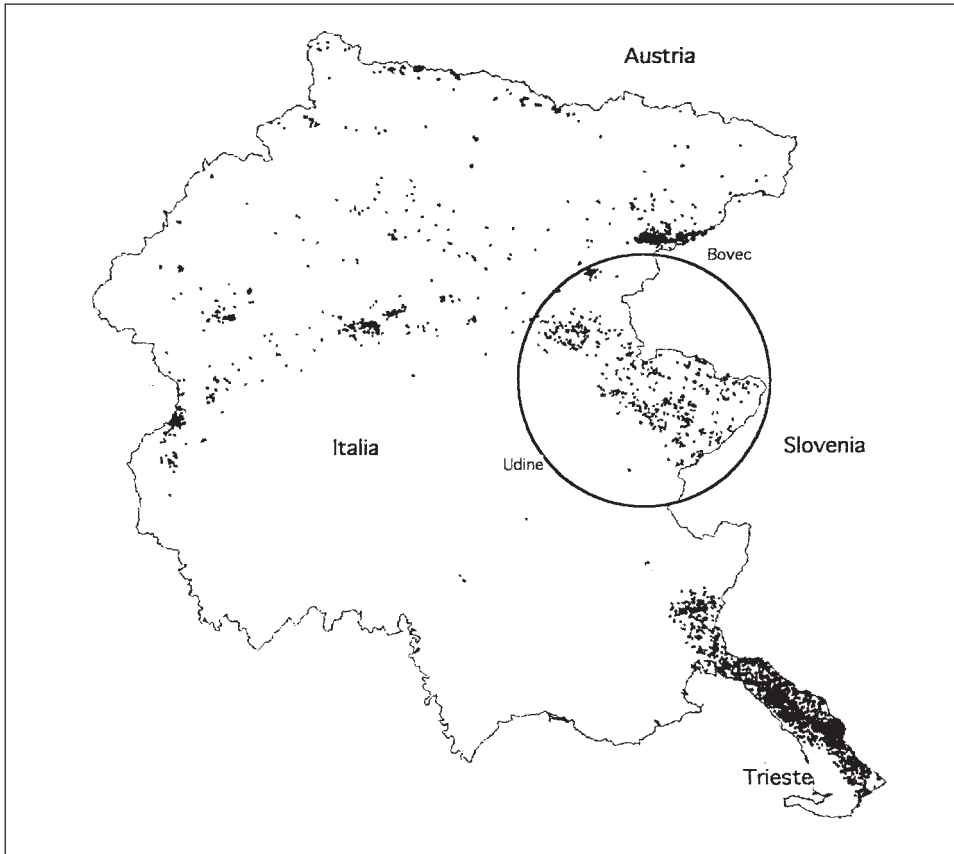


Fig. 1: The circle indicates the studied area in the Friuli Region.

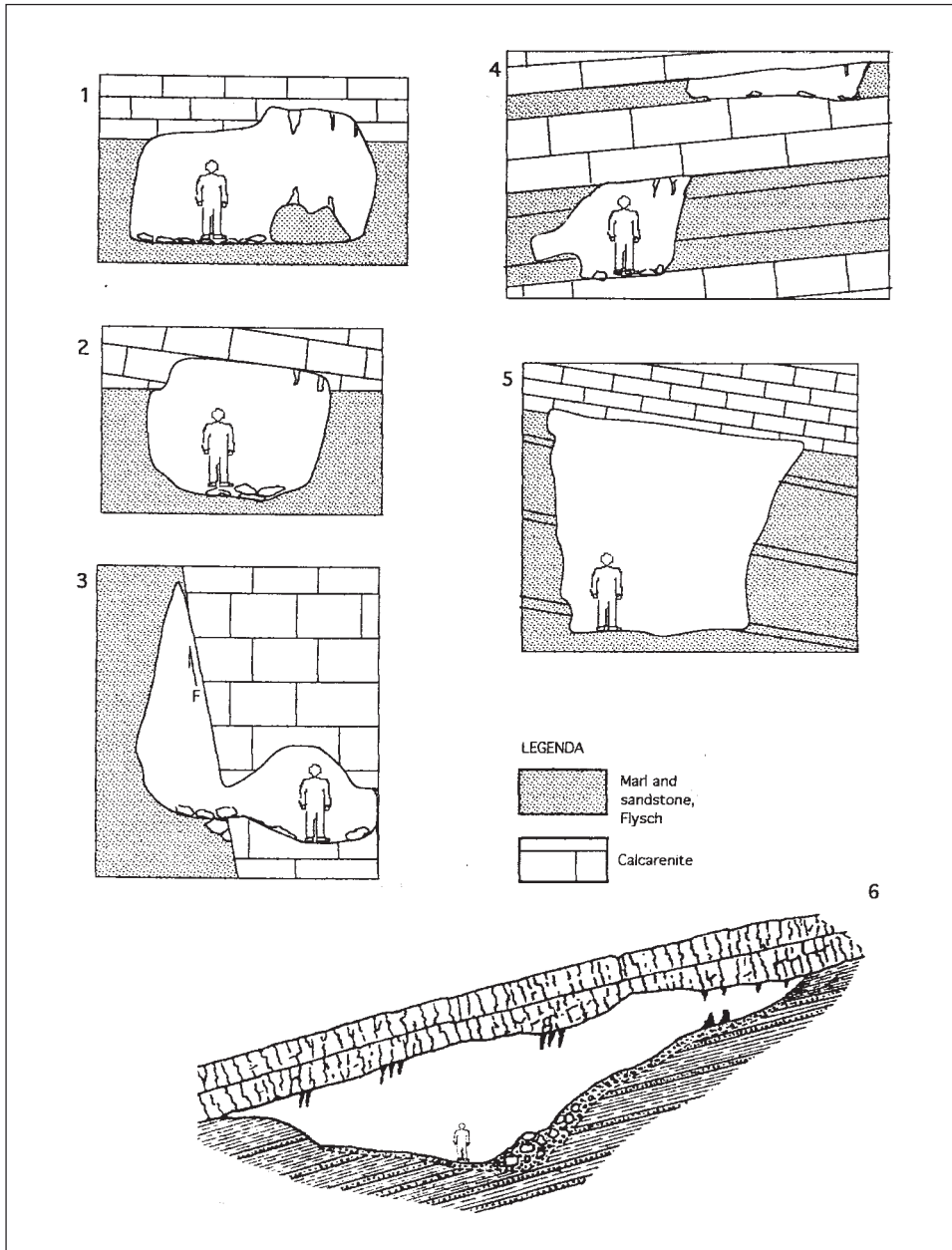


Fig. 2: Cross-sections of some contact caves. 1 Star Cedàt cave, “ramo mucca pazzo” - Natisone Valley. 2 Star Cedàt cave, “ramo delle sale” - Natisone Valley. 3 Star Cedàt cave, “ramo della faglia” - Natisone Valley. 4 St. Andrea cave - Natisone Valley. 5 La mitica cave - Natisone Valley. 6 Villanova cave, “sala regina Margherita” - Bernadia Mountains.

## **MORPHOLOGY AND EVOLUTION OF CONTACT CAVES**

Of particular interest is morphology, quite different as compared to the other caves. Lithology highly conditions the cave morphology, cross-section has usually a rectangular or trapezium shape, due to a flat calcarenitic ceiling and subvertical walls in marl and sandstone strata of decimetric thickness.

Walls geometric aspect can be related to an intense fixility with fractures perpendicular to strata beds due to a compressive tectonic activity.

This morphologic scheme can vary in a few ways because of top collapses or neotectonic activity that modify the original shape.

On the ceiling of a lot of caves the primary channel is visible.

In other situations the cave can develop only inside clastic rocks and not inside the limestone beds, in this case the cross-section is often subcircular, with a compact sandstone strata at the top. Usually these parts inside marl and sandstone are not so long compared with the complete plan of the cave and are very unstable. Cavers know very well these risky parts; fortunately some times calcite flowstone or stalagmites cover and cement the unstable flysch walls of caves.

On the basis of several observations the evolutive model of these contact caves can be summarized as follows:

- tectonic fracture of limestone megabeds, permeability increase and underground water flows at the calcarenite-marl contact start developing a karst system;
- at the beginning a subcircular karstic conduct develop mainly inside the calcarenite beds;
- water increase in the system and start engraving marl and sandstone deposits;
- the cave develop mainly in those clastic rocks with a complex mechanism of erosion and dissolution.

The marl calcareous part is chemically dissolved, on the opposite sandstone destruction is caused by a sequence of micro-rock detachment from strata in relief by selective erosion, clastic material are easily transported by the cave river.

There is also a physical action caused by dehydration of marl in same parts of the caves where there is a high variation in humidity. When we study the water analysis of these caves,  $\text{SiO}_2$  is quite high, so it seems to be also a slow chemical water attack on silicates present in sandstone.

## **CONCLUSIONS**

Calcarenite beds present in the flysch formation are seats of a diffused karstic phenomena; in particular it is noted that the greater part of the caves have set up in contact between the carbonate beds and the lower marls and sandstone of the flysch. This phenomena can be considered the main feature of the caves of the Natisone Valleys and Bernadia mountains. The analysis of the internal morphology of the caves, characterized by the contact marls-limestone, points out some common features and a possible evolutive model, based on a process defined as „erosive-dissolutive” process that is especially active on the marly part of the flysch. From the observations carried out on the Massif of La Bernadia Mountains and the valley of the river Natisone it can be stated that the caves are wider and develop faster inside the marly sandstone fraction of the flysch rather than the mere carbonates. In fact the wider areas of the inspected caves have origi-

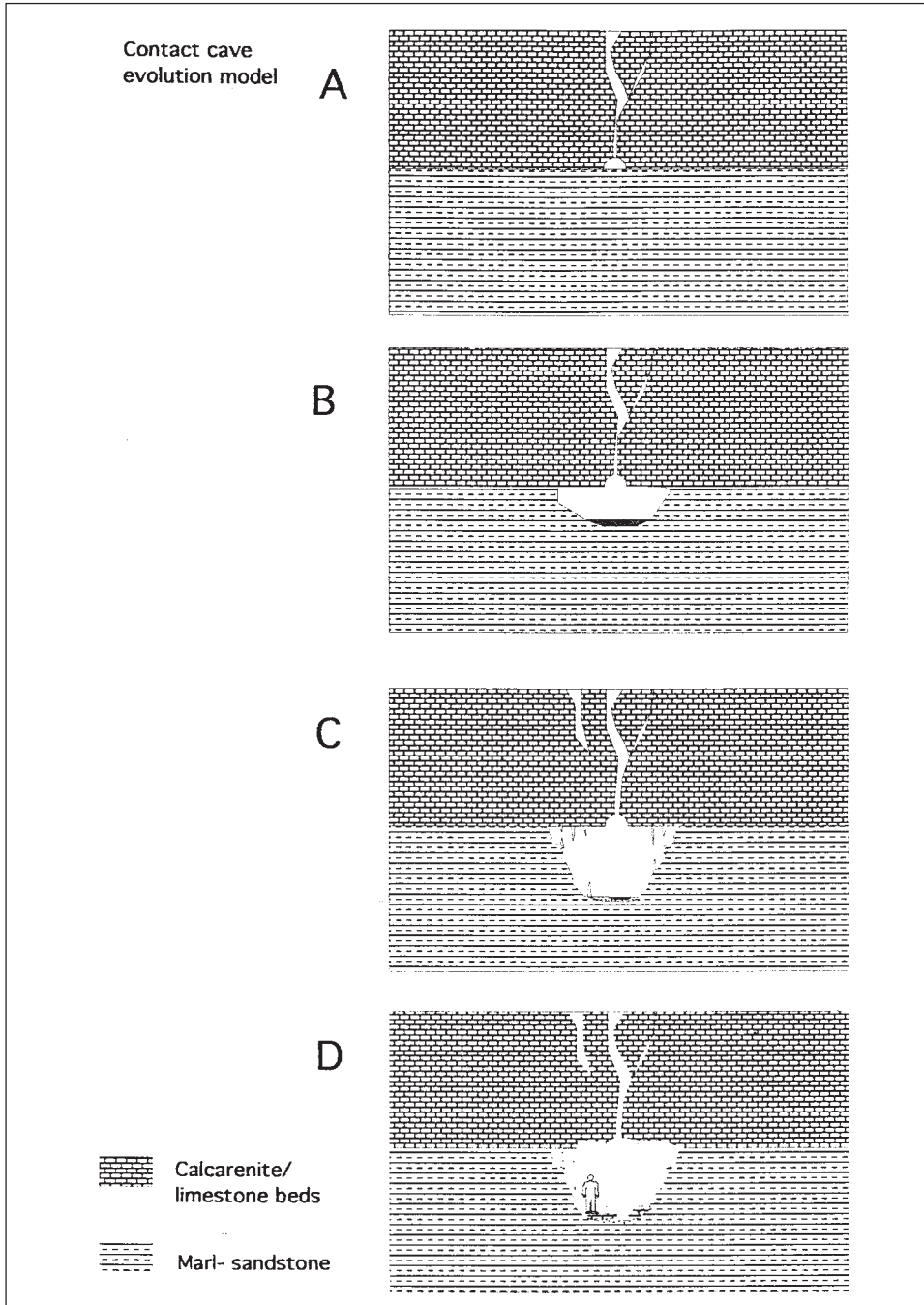


Fig. 3: Contact cave evolution model.



*Photo 1: Villanova cave in Bernadia Mountains, the cave is mainly developed inside flysch marl and sandstone beds, the limestone strata constitutes the compact and massive ceiling.*

*Photo 2: Feruglio cave in Bernadia Mountains, in this typical situation water flows in a small channel inside limestone strata at the contact with marl and reaches the main channel of the cave completely developed inside marl and sandstone of the flysch formation.*



nated inside the marly sandstone rocks rather than in the calcarenite; these natural caves demonstrate the importance of the flysch deposits in the karstic landscape widening the concept of the karstic process. Some research themes about the natural caves in this area have been determined on the basis of the morphology of the slopes and of the geological situation. It is more probable to dis-

cover them in contact with marls-calcarene, in proximity to local anticlines and rarely in proximity to the beds of the main valleys. These zones prove to be a particular territory and scientifically interesting for the analysis of karstic phenomena.

## BIBLIOGRAPHY

- Comar M., 1986: Speleogenesi nei sedimenti arenaceo - marnosi del cividalese. Sopra e Sotto il Carso, anno III, n. 3 C.R.C. Seppenhof, Gorizia.
- De Gasperi G.B., 1907: Grotte di Prestento. Mondo Sotterraneo, anno III, Udine.
- De Gasperi G.B., 1914: Fenomeni carsici della Valle di Prestento. Mondo Sotterraneo, anno X, Udine.
- De Gasperi G.B., 1916: Grotte e Voragini del Friuli. Mondo Sotterraneo, anno XI, Udine.
- Feruglio E., 1953: La regione carsica di Villanova in Friuli. Pubbl. dell'Istituto di Geologia dell'Università di Torino, Torino.
- Mocchiutti A. & Trevisani R., 1994: Morfologie ipogee e idrogeologia della grotta la Mitica (Valli del Natisone). Mondo Sotterraneo, anno XVIII, n. 1-2, Udine.
- Mocchiutti A., 1996: La risorgiva Star Cedât: una riscoperta importante. Mondo Sotterraneo, anno XX, n. 1-2 1996 Udine.
- Mocchiutti A., Lupieri L., Muscio G. 1996: L'evoluzione del fenomeno carsico nei Monti la Bernadia. In: Il fenomeno carsico dell'altipiano del Bernadia - Mem. Ist. It. Spel, x, s. II, 1996 - Provincia di Udine.
- Tellini A., 1898: Peregrinazioni speleologiche. In Alto, Cronaca della Soc. Alpina Friulana, Udine.
- Tunis G. & Venturini S., 1984: Stratigrafia e sedimentologia del flysch maastrichtiano-paleoceno del Friuli Orientale. Atti del Museo Friulano di Storia Naturale, n. 6, Udine.
- Tunis G. & Venturini S., 1988: Nuovi dati ed interpretazioni sulla tettonica del settore meridionale delle Prealpi Giulie e della regione al confine tra Italia e Slovenia. Atti del Museo Friulano di Storia Naturale, n. 10, Udine.

## KONTAKTNE JAME V FLIŠNIH FORMACIJAH FURLANIJE

### Povzetek

Večina jam v flišnih formacijah doline reke Nadiže doline in območja Monte Bernadie je razvitih ob kontaktu med apnenčastimi plastmi in pod njimi ležečimi plastmi laporja ali peščenjaka. Na osnovi morfološke študije jam, avtor predlaga sledeč model speleogeneze opisanih jam:

- voda, ki teče ob kontaktu apnencev in laporjev korozivno oblikuje inicialne kanale v apnencu
- z rastjo inicialnih kanalov se pretok vode večja, kar povzroči mehansko odnašanje spodaj ležeče plasti laporja ali peščenjaka

Za jame so značilni ravni apnenčasti stropi v katerih so lepo ohranjeni inicialni kanali, katerih razvoj se ustavi po preboju, ko se začne erozija v laporju ali peščenjaku. Karbonatni del laporjev voda deloma raztaplja, deloma odnaša skupaj z nekarbonati. Avtor navaja visoko vsebnost silikatov v vodi, kar naj bi kazalo tudi počasno raztapljanje silikatnih mineralov v peščenjakah.