Catholic University of Eichstätt-Ingolstadt, Department of Geography

Actualistic approaches for the interpretation of clastic deposits of the Mühlbach Cave, Germany

Martin Trappe, Eichstaett

Introduction

The Mühlbach Cave was discovered in 2001 by speleologists after intense digging activities. With a length of more than 7 km today it is among the longest caves in Germany. The cave is located in the South Franconian Alb (Fig. 1), a karstic area showing limestones and dolomites of Jurassic Age. Most cave passages show active streams discharging 300 l/s and transporting gravels and sandy-silty sediments (Fig. 2, 4). The Mühlbach cave offers the opportunity to study undisturbed fluvial cave sediments in relation to the hydrological conditions.

Fig. 1: Regional overview of the research area.

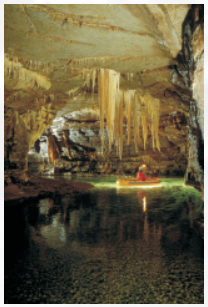

Fig. 2: Typical view of cave passages in the Mühlbach cave (Foto: Armin Schnobrich, Copyright: KGM e.V.).

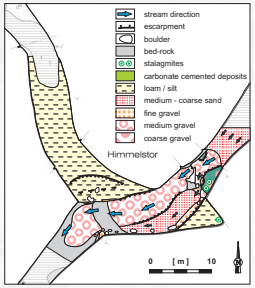

Fig. 3: Geological map of cave deposits observed at the confluence of the main cave passage and an abandoned passage.

Methodology

Main focus was set on mapping and sampling of different sedimentary environments of clastic cave deposits to characterise a broad spectrum of cave sediments directly related to the sedimentary facies (Fig. 3-5). These samples act as reference material for the interpretation of samples which did not show any relation to fluvial or other facies (actualistic approach). Especially fine sand to silt outcrops at the cave walls or similarsuccessions drilled by a manual auger at the bottom of abandoned passages had to be identified (Fig. 6).

Fig. 4: View to the main cave passage with a central stream bed showing fine gravels and fine-grained overbank deposits (Foto: Armin Schnobrich, Copyright: KGM e.V.).

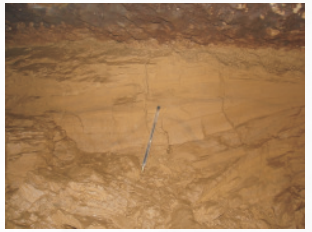

Fig. 5: Sequence of laminated fine silt exposed at an abandoned passage (Foto: Martin Trappe).

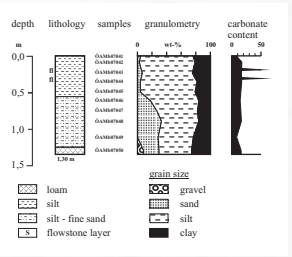

Fig. 6: Sedimentpetrography of cave deposits drilled in an abandoned cave passage.

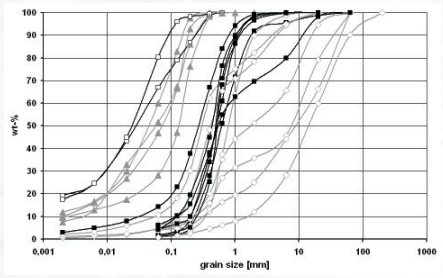

Fig. 7: Cumulative grain size curves of fluvial cave deposits from different facies domains at the Mühlbach cave site (actualistic approach). Unfilled quadrangles – limnic deposits, grey triangles – overbank deposits, black quadrangles – side bar or point bar, unfilled rhombi – channel bed deposits.

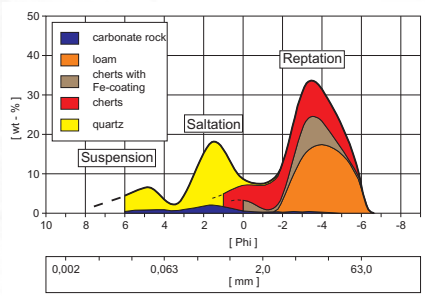

Fig. 8: Typical variation of lithology across the grain size distribution of a selected sample.

First results

A rough distinction between channel-fill, channel and point bar, natural levée and overbank deposits was made along the active streams. Abandoned passages behind natural levées show a continuous grain size decrease with increasing distance to the levées. Often the sedimentary environment changes to lacustrine conditions which are disturbed by fluvial input only in a few episodic cases. Mostly the connections to the main passage are interrupted and water supply is fed mainly by drip water. The facies separation is confirmed by the sedimentpetrographic data (Fig. 7, 9). Facies diagrams (e.g. BOSCH & WHITE 2004) can be used for sediment differentiation (Fig. 9, 10).

Although only minor fragments of carbonate rocks occur (strongly corroded limestones, speleotheme fragments) higher portions of dolomite grains are observed within the sand fractions. It can be concluded that these grains result from a granular disintegration of dolomitic rocks at higher levels of the cave (Fig. 8).

Except of silt and fine sand transported as suspension load no important dislocation of sedimentary material was observed within the Mühlbach Cave.

Although larger floods were documented for historic times the depositional setting of this cave has to be interpreted as a calm fluvial environment. Due to its lower hydrological dynamics it is different from the typical Fluviokarst.

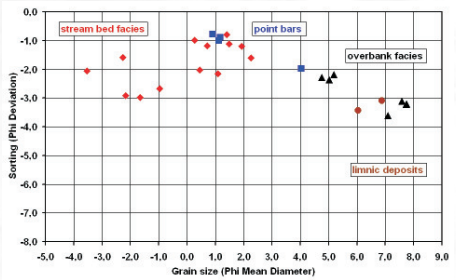

Fig. 9: Discrimination of recent samples taken with respect to the fluvial facies due to BOSCH & WHITE (2004).

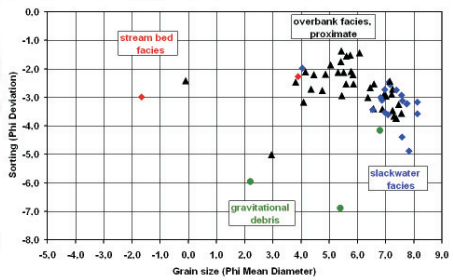

Fig. 10: Discrimination of fluvial facies domains applied to samples from abandoned passages and thick sequences of unknown origin.

Fig. 11: Laminated fine silt and flowstones (Foto: M. Trappe)..

References

BOSCH, R.F. & WHITE, W.B. (2004): Lithofacies and transport of clastic sediments in karstic aquifers. -In: SASOWSKY, I.D. & MYLROIE, J.W. (eds.): Studies of cave sediments: Physical and chemical recorders of climate change: 1-22, Kluwer.

TRAPPE, M. (2007): Gliederungsmöglichkeiten und Systematik von klastischen Höhlensedimenten (Beispiel Südliche Frankenalb). – Laichinger Höhlenfreund, 42 73-88.

TRAPPE, M. (2009): Sedimentpetrographie, Gliederung und Entstehung von Karstsedimenten am Beispiel der Südlichen Frankenalb. – Unpublished Habilitation Thesis, Catholic University Eichstaett-Ingolstadt.

Acknowledgement:
I thank the members of the caving club "Karstgruppe Mühlbach" (KGM e.V.) for their technical and personal support during the field campaigns and the owner of the Mühlbach cave for the permit to enter the cave.

CATHOLIC UNIVERSITY EICHSTÄTT INGOLSTADT
LEHRSTUHL PHYSISCHE GEOGRAPHIE

Author adress:

Dr. Martin Trappe
Department of Geography
Catholic University Eichstaett-Ingolstadt
Ostenstr. 18
D-85072 Eichstaett, Germany

email: martin.trappe@ku-eichstaett.de

Geophysical Research Abstracts,
Vol. 11, EGU2009-10425, 2009
EGU General Assembly 2009

Actualistic approaches for the interpretation of clastic deposits of the Mühlbach Cave, Germany

M. Trappe
University Eichstaett-MGF/Geography, Eichstaett, Germany (martin.trappe@ku-eichstaett.de)

The Mühlbach Cave was discovered in 2001 by speleologists after intense digging activities. With a length of more than 7 km today it is among the longest caves in Germany. The cave is located in the South Franconian Alb, a karstic area showing limestones and dolomites of Jurassic Age. Most cave passages show active subsurface streams discharging 300 l/s and transporting gravels and sandy-silty sediments. Because of lacking of a natural cave entrance there is the opportunity to study undisturbed fluvial cave sediments in relation to the hydrological conditions.

Main focus was set on sampling of different sedimentary environments of clastic cave deposits to characterise a broad spectrum of cave sediments. These samples act as reference material for the interpretation of samples which did not show any relation to fluvial or other facies (actualistic approach). Especially fine sand to silt outcrops at the cave walls or similar successions drilled by a manual auger at the bottom of abandoned passages had to be identified.

A rough distinction between channel-fill, channel and point bar, natural levee and overbank deposits was made along the active cave streams. Referring to the distinct hydrological conditions a detailed morphological and geological mapping was performed for a few localities. Streambed samples show often rounded gravels of medium size or sandy gravels. Lithologically they comprise mainly cherts and quartzites derived from the karst surface. Although only minor fragments of carbonate rocks occur (strongly corroded limestones, speleotheme fragments) higher portions of dolomite grains are observed within the sand fractions. It can be concluded that these grains result from a granular disintegration of dolomitic rocks at higher levels of the cave. They were displaced through vertical shafts into the active streams. Grain size data from point bars, natural levees and marginal overbank deposits exhibit clear sorting of the unimodal sediments and a gradual shift of cumulative grain size curves to finer material.

Abandoned passages behind natural levees show a continuous grain size decrease with increasing distance to the levees. In case of flooding the natural levee deposits are highly affected by the dynamics of the adjacent cave stream (proximate facies). More distant areas display finer grain sizes due to the reduced current velocities (distal facies). Often the sedimentary environment changes to lacustrine conditions which are disturbed by fluvial input only in a few episodic cases. Mostly the connections to the main passage are interrupted and water supply is fed mainly by drip water. The limnic cave sediments are often fine laminated and consist of fine silt and minor clay. The discrimination between different sedimentary environments was also performed by facies diagrams using sorting and grain size parameters.

Except of silt and fine sand transported as suspension load no important dislocation of sedimentary material was observed within the Mühlbach Cave. Although larger floods were documented for historic times the depositional setting of this cave has to be interpreted as a calm fluvial environment. Due to its lower hydrological dynamics it is different from the typical Fluviokarst.