a mention anywhere, even in the entry on 'Inception of Caves', yet the great importance of the concept is stressed in a brief biography of Bögli on p.381. Errors seem very few but the one that did hit me concerns the most important definition in the entire volume, that on 'Karst' (also cited in the editor's introduction), which fails to recognise the fundamental distinction between porosity and permeability of rock.

Despite minor niggles, which no doubt can be found in every book of this size, this encyclopedia certainly will prove an invaluable source reference for students and teachers in higher education. On the whole it fulfills this role admirably with generally concise, well written accounts of the various topics, each followed by a list of cited works and/or further reading. The index is very extensive, although at times rather confusing. The price might seem rather high but that should be weighed up against the size of the book and the large number of entries from a diverse range of experts. Certainly all higher education establishments teaching any of the sciences should hold a copy in their library, as should anyone with a broad interest in geomorphology. Its contents too are very pertinent to particular disciplines within biology and archaeology. For the amount and breadth of information contained within this volume, it really is good value and every reader should find plenty to interest them.

Mike Simms

Incomplete solution: weathering of cave walls and the production, transport and deposition of carbonate fines. Nadja Zupan Hajna. 2003. Carsologica, ZRC Publishing, Slovenian Academy of Sciences and Arts, Postojna - Ljubljana, Slovenia. 167pp. Price €14.93. ISBN 961 6358 85 5. Available from: Založba ZRC / ZRC Publishing. P.O. Box 306 SI-1001 Ljubljana, Slovenia Fax: +386 1 425 77 94 E-Mail: zalozba@zrc-sazu.si

This monograph concerns the weathering of limestone and dolomite on the walls of cave passages in nine Slovenian caves, and the deposition of autochthonous carbonate lithoclasts in four others. Many of us have noticed that weathered cave walls are often pale and sometimes covered by a thick, soft zone of a white, clay-like substance. Nadja Zupan Hajna at last provides us with an explanation, but not one that we might expect. The clay and the zone of paler, weathered wallrock prove to be almost identical to the parent rock in their mineral and chemical composition, only more porous. Karst theory predicts that limestone should dissolve completely, leaving only the insoluble component of the bedrock as a residue on the cave wall. Yet here we have evidence of incomplete limestone solution, with a *soluble* residue of loosely attached carbonate grains. These grains are easily removed by mechanical erosion, such as rinsing by flowing water. The carbonate fines are then transported in suspension by cave streams where they may dissolve, be carried out from the cave, or be deposited within the cave as a sediment.

In Nadja Zupan Hajna's case studies, the most weathered bedrock is found where percolation water soaks the cave walls at the junction with floor sediments, and also where the walls are exposed to condensation corrosion. In these places, thick layers of carbonate fines remain in place because they are protected from further dissolution and from mechanical erosion. In an experiment on a sample of weathered limestone, she found that it could absorb 10% by weight of moisture in a mere 5 minutes. In a cave setting, aggressive water would be drawn into the limestone, away from the surface layer of fines. To erode these fines, periodic cascades or water trickles must flush the cave walls after rainfall. This is most apparent in stepped shafts, where the highest proportion of carbonate clasts were found in floor sediments.

The monograph is very attractively presented with a total of 133 figures, almost one per page. These figures include maps, cave surveys, line drawings, charts, colour diagrams, colour photographs and SEM photographs. The presentation of the text in English is generally good, though some traces of eastern European sentence structure and phraseology are retained. This is inevitable in a work of this sort, since a perfect translation would require equal abilities in the English language and in the scientific subject matter. The author's own "Foreword" and the first sentence of the "Introduction" seem to have been late additions that were not put through a language review. This is a pity, since they are prominent at the start of an otherwise well-written and understandable text. The monograph concludes with a brief summary in the Slovenian language.

A study of calcite mud may not seem the most exciting topic in cave science, but this is a hugely important piece of research that changes our understanding of karst processes. It is also of particular interest to this Society. The traditional explanation for the formation of karst caves is chemical solution of the bedrock. By this it is meant that cave passages increase in size by progressive total dissolution of exposed rock surfaces. As part of his postgraduate research at Bristol University, Malcolm Newson (1971) found that mechanical erosion also plays an important role in cavern development. In the caves of the Mendip Hills, siliceous sand which enters at the swallets becomes smaller and more rounded as it abrades the cave walls. Meanwhile, the sediment suspended in the cave streams becomes enriched with calcareous silt.

Most modern descriptions of karst make a reference to mechanical abrasion, but still claim that corrosion/solution is the dominant process. Self and Mullan (1996) challenged this viewpoint on the grounds that quantitative research has been restricted to material removed in solution. They suggested that karst is a product of both processes, the balance between them depending on both terrain and lithology. Controversially, they recommended the inclusion of groundwater-formed caves in arenaceous rocks into karst. One weakness of their argument was that caves in quartzite only form in rock that has been deeply weathered. This process is called *arenisation*, whereby groundwater moving along joints and bedding planes leaks into the bedrock along crystal boundaries, dissolving and separating the grains and leaving them susceptible to mechanical erosion by piping. Martini (1981) explained that poorly soluble quartz also has a very slow speed of dissolution, allowing water to penetrate deeply into the fabric of the rock before saturation is reached. Calcite is more soluble than quartz, but crucially it has a much faster rate of dissolution which (theoretically) should prohibit arenisation. For Martini, the cave-forming process in quartzitic rocks was clearly different.

Nadja Zupan Hajna now presents us with a monograph on the arenisation of limestone, and not just any limestone. This is the Classical Karst of Slovenia, the region that gave its name to the term *karst*. If it happens here, you will find it repeated all across the world. Moreover, the Karst Research Institute at Postojna, the internationally respected field centre of the Slovenian Academy of Sciences and Arts, supported and published this study.

We now have a new insight into how caves form in limestone. Chemical solution takes place at the rock surface, in the near-surface region of the bedrock, and from particulate matter in suspension in cave streams. Mechanical erosion is not just abrasion by allochthonous material, but includes the simple washing away of carbonate fines produced by incomplete solution of the wallrock. With these new variables in the equation that describes *karst process*, cave science has become both more complicated and more interesting.

Charlie Self

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