sample had compromised the locations, such as occurred where a section of slate cleaved off during a second pull. Others were excluded on the grounds of the slate feeling soft on drilling, suggesting a poor zone of slate that should not be used for placing anchors. It has to be admitted that a few anchors were excluded on the grounds of being subject to installation error, such as insufficient resin or failure of the anchor to properly seat. The excluded anchors included all those whose results lay below 20kN.

Unfortunately, the size of many of the resultant subsets of data invalidates a range of statistical tests. It is likely that a few more samples in these subsets would be sufficient to enable proper statistical analysis of the six variables.

The results show that the BP anchor meets the E&T criteria for adoption in the four types of North Wales slate found at Cwmorthin (Back Vein and Stripey), Cambrian and Braich Goch. BCA's Equipment & Techniques Committee has designated the BP anchor for use in these slates.

The results also show that both the Collinox anchor and the 12mm Goujon expansion anchor coupled with the Coeur hanger meet both the European Standard and the UIAA criteria in all four types of North Wales slate. The results for the Collinox anchor supports a claim that the Batinox anchor (which is a larger version of the same design as the Collinox) is likely to also meet the European Standard and the UIAA criteria in the four slates. While the results indicate the IC anchor would also meet the E&T criteria, the work will have to be repeated using its approved resin to gain such recognition.

A suggestion of a link between depth of placement and extraction force was considered and Table 3 presents the mean force together with the length of the shank of the anchor and diameter of the drilled hole. The data shows no clear relationship.

Notably, the Goujon anchors which failed below 37kN did so by being extracted from the rock, while those which failed above 37kN did so because the Coeur hanger snapped. The Coeur hanger is rated to 25kN; it is emphasised that the hanger was subject to distortion in all cases.

Extracting the anchors using the BCA anchor puller did create substantial damage to the anchor location in the majority of cases and BCA's Equipment & Techniques Committee is considering this negative conservation factor.

Typical spalling of surface layers following extraction of an anchor

A flake of slate loosened by the first anchor extracted (leaving a hole) and released from the rock face by a second anchor (still attached) *Photos: Gethin Thomas*

Our thanks go to the many people who helped by carrying the anchor puller and gear to the work locations.

More details of the results and the statistical analysis may be found on the BCA website at: http://tinyurl.com/bca-anchors.