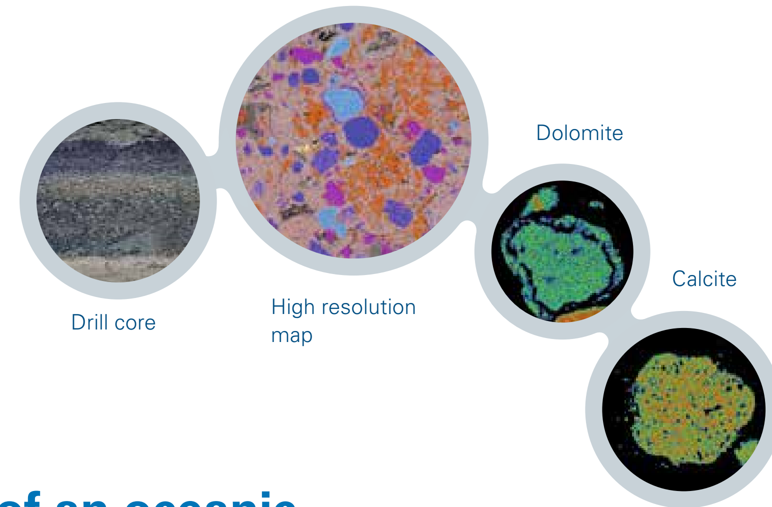

Application Note # EDS-07

High resolution mapping of an oceanic drill core using the XFlash® Silicon Drift Detector (SDD)

Recent research results suggest that the 180 km-sized Chicxulub impact crater on the Yucatán peninsula in Mexico is responsible for the end of the dinosaur age 65 million years ago at the geologic boundary between the geological epoch Cretaceous and Palaeogene (K-Pg or KT boundary). This study focuses on a 2-cm thick ejecta layer present at the oceanic drill core ODP Leg 207 at ~4500 km distance from the impact crater.

Method

A high resolution element mapping of the transition of the upper ejecta layer to Palaeogene sediments has been carried out at high input count rate within a short time using the QUANTAX EDS system including an XFlash® SDD. The following measurement conditions were used:

Detector:	XFlash® 4030
Resolution:	4096 x 3072 pixel (~0.5 µm per pixel)
Acquisition time:	33 minutes
Input count rate:	500,000 cps
Output count rate:	250,000 cps

Results

The high resolution composite element map (Fig. 1 and Fig. 2) displays a distinct layer in the uppermost millimeters of the ejecta deposit. It comprises abundant calcite ($CaCO_3$) and dolomite [$(Ca,Mg)CO_3$] spherules, few shocked quartz (SiO_2) fragments and aluminosilicate grains such as feldspar [$(K,Na)AlSi_3O_8$, $NaAlSi_3O_8$ –$CaAl_2Si_2O_8$]. The dolomite spherules have irregular serrated boundaries enclosed by a layered clay shell (Figs. 3A-D) indicating impact-induced mechanical and thermal stress during the impact event. The porous calcite spherules (Figs. 3 E-H) resemble experimentally produced degassing textures.

Conclusions

The high count rate offered by the XFlash® SDD detector allows the acquisition of high resolution element maps within a short time. This high resolution permits zooming in and displaying smaller features without the need of additional measurements.

High resolution map

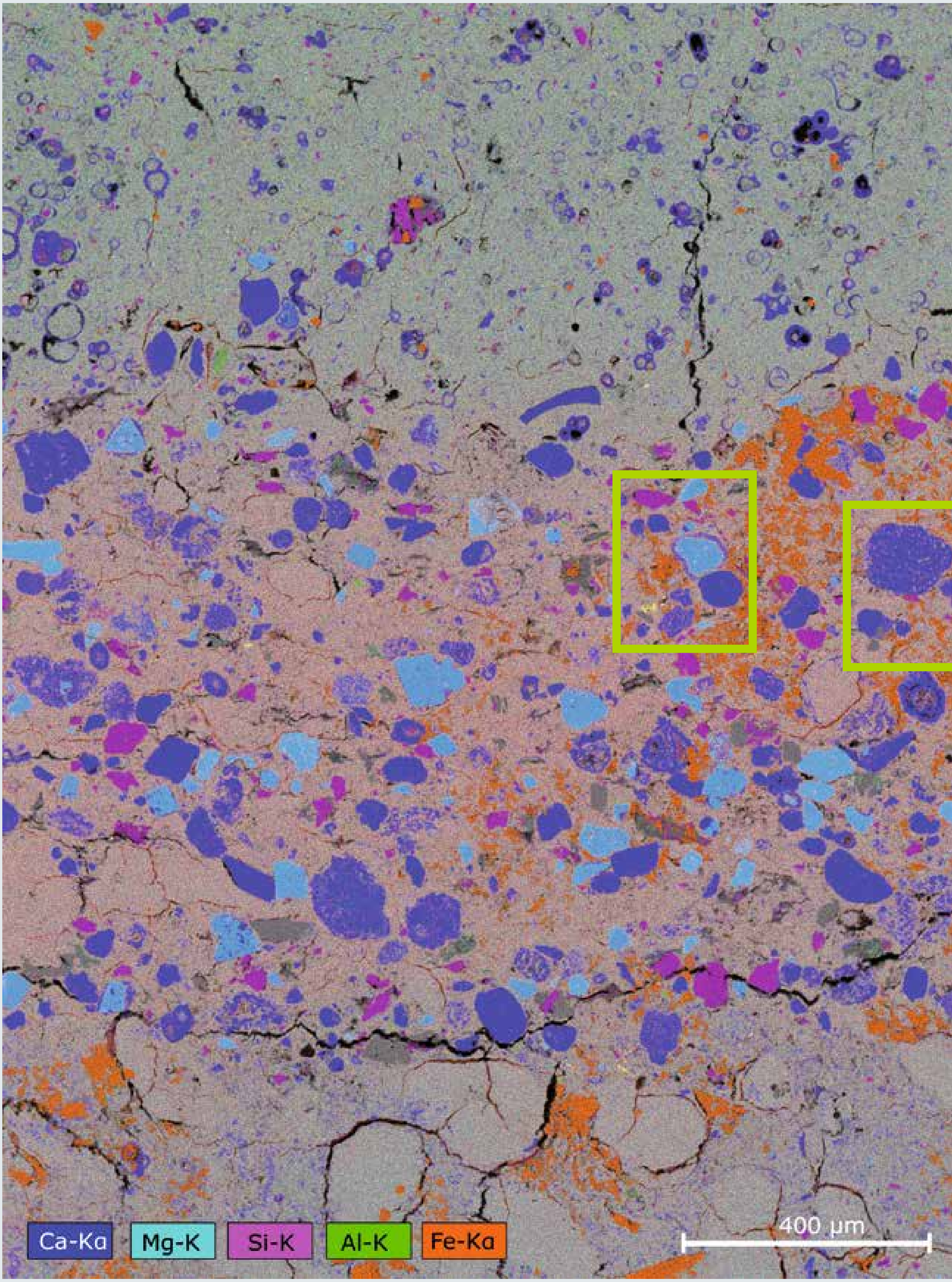

Fig. 1 High resolution EDS map (3072 x 4096 pixels) showing the uppermost part of the ejecta deposit in ODP Leg 207 and the transition to the early Palaeogene claystone above. Note that the occurence of carbonates (calcite, dolomite) and quartz is clearly restricted to the top 0.5 to 0.7 mm of the ejecta deposit. The areas in the green rectangles were magnified in Fig. 3.

Single element distributions in false colors

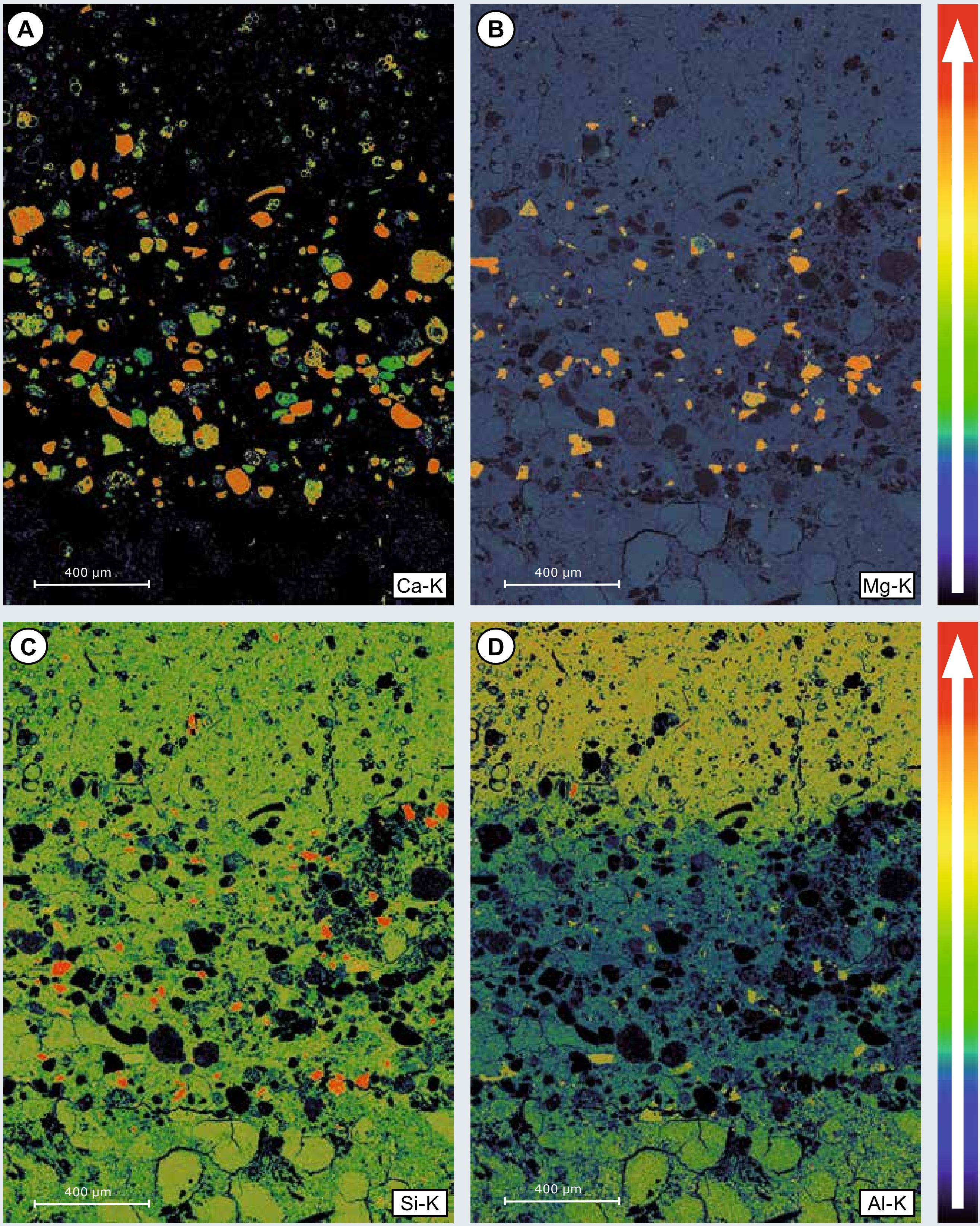

Fig. 2 Element distribution in false colors. (A) Calcium map showing the distribution of carbonates. Note the higher intensity of calcium carbonate (calcite, orange) and lower intensity of calcium magnesium carbonate (dolomite, green). (B) Magnesium map showing the distribution of calcium magnesium carbonate (dolomite). (C) Silicon map showing the distribution of silicon dioxide (quartz). (D) Aluminum map showing the distribution of aluminosilicates such as feldspars.

Composite image

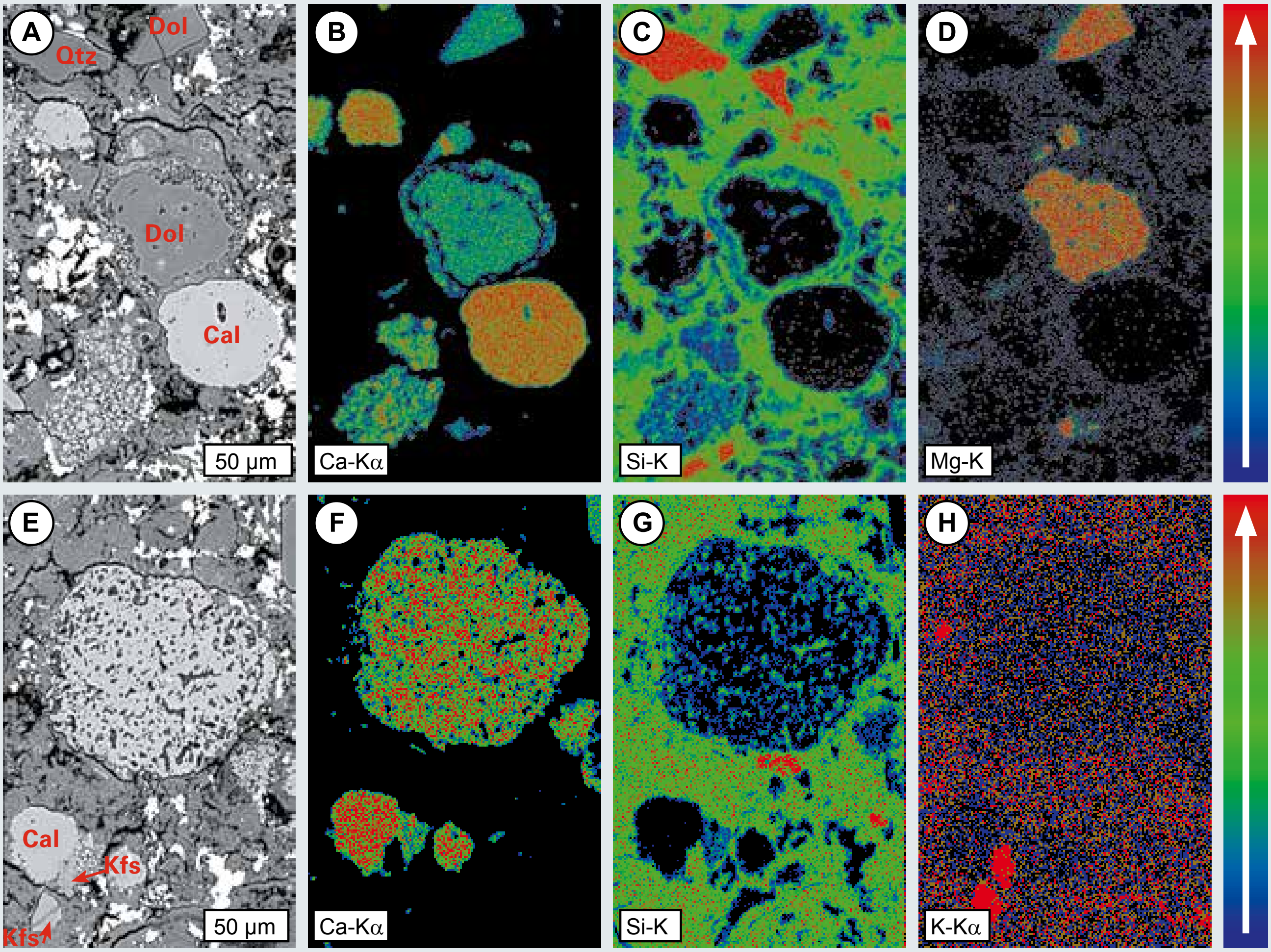

Fig. 3 (A-D) BSE image and EDS element maps (331x525 pixel) showing a dolomite particle with corona and angular quartz fragments. (E-H) BSE image and EDS element maps (355x486 pixel) of a calcite particle with a porous, foam-like texture. The EDS maps here are enlarged sections of the high resolution map (Fig. 1). The EDS maps permit to discriminate the minerals quartz (C) from dolomite (D) and calcite (F) from potassium feldspar (H) (see also application note EDS-02). Cal: calcite; Dol: dolomite; Kfs: potassium feldspar; Qtz: quartz.

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Detailed studies of this sample are presented in Schulte P.; Deutsch A.; Salge T.; Berndt J.; Kontny A.; MacLeod K.G.; Neuser R.D.; Krumma S. (2009): *A dual-layer Chicxulub ejecta sequence with shocked carbonates from the Cretaceous–Paleogene (K–Pg) boundary, Demerara Rise, Western Atlantic*, Geochimica et Cosmochimica Acta 73 1180–1204.

All configurations and specifications are subject to change without notice. Order No. DOC-A82-EXS007, Rev. 1.1.
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