Cathodoluminescence (OM–CL) imaging as a powerful tool to reveal internal textures of minerals

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Cathodoluminescence (CL) is a common phenomenon in solids (minerals) that results from complex physical processes after excitation by electrons. OM–CL imaging is a modern luminescence technique with widespread applications in geosciences and materials sciences. Many rock-forming and accessory minerals show specific CL properties which can be successfully used in geoscientific research. A lot of investigations on geo-materials illustrate that it is possible to visualise growth textures and other internal textures in crystals that are not discernible with other analytical techniques (Marshall, 1988; Barker and Kopp, 1991; Götze, 2000; Pagel et al., 2000; Nasdala et al., 2004; Schertl et al., 2004; Boggs and Krinsley, 2006; Gucsik, 2009; Götze et al., 2013).

Because of the fact, that luminescence of minerals is predominantly a defect luminescence, the combination of CL imaging and spectroscopy can be used for the spatially resolved analysis of point defects. The additional combination of CL microscopy with other advanced analytical methods with high sensitivity and high spatial resolution allows an effective investigation of a wealth of geological and synthetic materials. The obtained information can be used for the reconstruction of processes of mineral formation and alteration, to provide information about the real structure of minerals and materials, and to proof the presence and type of lattice incorporation of several trace elements (Fig. 1). Therefore, the close relation between specific conditions of mineral formation, real structure and the CL properties may provide important genetic information concerning geological and technical processes.

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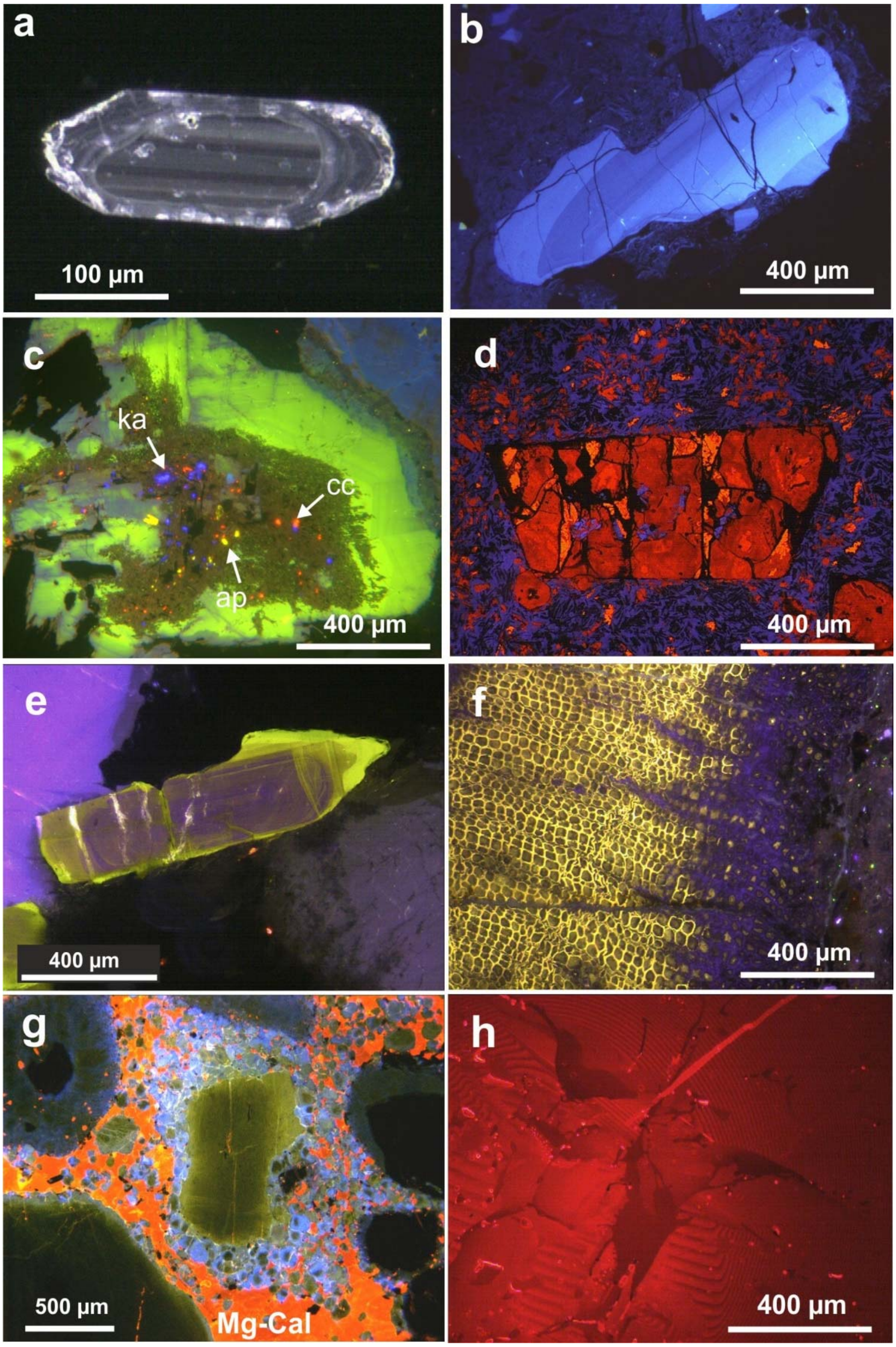

Fig. 1. *CL micrographs showing internal textures in different minerals;* ***a*** *Zircon crystal from the Erzgebirge, Germany, with a strongly zoned relict core and a secondary rim which is only visible under CL;* ***b*** *K-felspar fragment from an ignimbrite of Chemnitz, Germany, with growth zoning visualized by CL;* ***c*** *Strongly altered plagioclase crystal in a granite from Demitz-Thumitz, Germany, with alteration products of carbonate (cc-orange CL), apatite (ap; yellow CL) and kaolinite (ka; blue CL);* ***d*** *Completly carbonatized pyroxene in an altered alkali basalt from South Africa;* ***e*** *Apatite crystal in a granite from the Krkonosze Massif, Poland, displaying distinct features of magma mixing visible in modified CL properties;* ***f*** *Silicified wood from Germany showing two generations of silicification in CL: a primary (yellow CL) and a secondary hydrothermal overprint (short-lived blue CL);* ***g*** *Zonation of diopside, calcsilicate rock, Kokchetav Massif, Kazakhstan (Mg-Cal = Mg-rich calcite);* ***h*** *Irregular growth pattern in synthetic ruby grown by the melting zone technique.*