The development of the failure process in complex macrosystems using large rock samples subjected to biaxial compression has been studied by means of electromagnetic radiation (EMR) and acoustic emission (AE). In order to increase the stage of macrofailure development, a special procedure of rock loading was used to reveal regularities of nucleation and evolution of electromagnetic and acoustic structures. The synchronised measurements of EMR and AE allowed the control of the stress–strain state in the rocks and the structural developments of fracturing. Nonhomogeneous distribution of the rock spatial crystalline structure subject to load leads to a mosaic distribution of EMR and AE characteristics. As a result, the crack scale effect may be observed in the EMR and AE structure behaviours. The EMR and AE following the failure at different levels behave differently according to the difference in the scale and type of cracks. Intense high-frequency EMR pulses were recorded during the initial stage of microcrack generation occurring prior to major failure of material. This was not the case for AE. The nucleation and development of the macroscopic progressive failure evolution caused an alternation in energetic and frequencial properties of electromagnetic and acoustic events. It has been detected that the tensile cracks were more efficient than shear cracks in capacity of EMR generation. The analysis of self potentials allowed reaching the maximum of registered anomalous variations in the stage of microcracking interaction. This stage showed an increase in the EMR activity, which implies the nucleation of microcracks in various regions of rock interfaces. The gradual accumulation of these defects led to weakening some parts of the rock along with a disintegration of electric anomalies, increase of AE and a significant fluctuation in the rate ofEMR. When crack concentration attains its critical value, which results in the formation of dangerous macroscopic failure of higher level, AE shows an intense activity as well as anEMRlower frequency. The hierarchical development of rock failure using the ratio of the average crack size and the mean distance between cracks as a statistical concentration criterion is used to control the boundary of the transition from small dispersed cracks accumulation to gradual crack merger and the formation of the main macrofailure. These results could be transferred into larger scale levels to forecast dynamic events in the earth crust