

## Multi-fractal analysis for ULF geomagnetic data to find earthquake precursors

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In our previous papers we have shown that the fractal (monofractal) dimension ( $D_0$ ) showed a significant increase before the Guam earthquake occurred on 8 August, 1993. In order to have a further support to this precursory effect to the general rupture (earthquake) we have carried out the corresponding multifractal analysis (by means of detrended fluctuation analysis) for the same data to study the statistical self-similar properties in a wide range of scales. We have analyzed the ULF geomagnetic data (the most intense H component) observed at Guam observatory. As the result, we have found that we could observe significant changes in the multifractal parameters at Guam such that  $\alpha_{\min}$  showed a meaningful decrease about 25 days before the earthquake and correspondingly  $w$  increased because  $\alpha_{\max}$  exhibited no significant change at all. The most sensitive parameter seems to be non-uniformity factor  $\delta$ . Correspondingly, the generalized multifractal dimension  $D_q$  ( $q$  more than 1) showed a significant decrease (whereas  $D_q$  ( $q$  less than 0) showed no change) and  $D_0$  ( $=D_q$  ( $q=0$ )) (as already found in our previous papers) is reconfirmed to increase before the earthquake. These multifractal characteristics seem to be a further support that these changes are closely associated with the earthquake as a precursor to the Guam earthquake, providing us with appreciable information on the pre-rupture evolution of the earthquake.