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Fractal analysis of Martian outcrops: microbialites on Mars

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Microscopic images collected by the Martian Rovers (Spirit, Opportunity, Curiosity) showed the presence of microstructures organized in intertwined filaments of microspherules: a texture similar to the one presents in terrestrial (biogenic) stromatolites and other microbialites and not in pseudo-abiogenic-stromatolites. We performed a quantitative image analysis in order to compare 50 microbialites images with 70 selected images collected by the Rovers ones (approximately 25,000/35,000 microstructures). Contours were extracted and morphometric indexes obtained: geometric and algorithmic complexities, entropy, tortuosity, minimum and maximum diameters. Terrestrial and Martian textures from all the locations resulted multifractals. Mean values and confidence intervals from the Martian images overlapped perfectly with those from terrestrial samples. The probability of this occurring by chance was less than $1/2^8$, $p < 0.004$. Our work shows the widespread presence of microbialites in the Martian outcroppings.