Giant Lineaments on the East Antarctic Ice Cap from RADARSAT Imagery

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Antarctica is by far the coldest, driest, windiest as well as the most remote continent and unexplored region of the planet. Direct evidences supporting existing geological and tectonic knowledge of the East Antarctica craton mainly derives from sparse outcrops located along the perimeter of the continent. Geophysical data and remotely sensed images acquired in the last decade furnished significant constrains for unravelling the tectonic evolution of the East Antarctic plate. Nevertheless to date lots of challenging questions still remain unanswered. Satellite images offer a unique point of view for regional studies of processes acting at continental scale, like ice sheet dynamics analysis and regional scale tectonic investigations. Radar imagery is likely to be an effective tool to study the relatively flat surface morphology of East Antarctic Ice Sheet (EAIS) interior since the incidence angle position of the radar wave remains unaffected by terrain-induced distortions, related to height topographical contrasts. Moreover the advantage of using active microwave satellite sensor rather than the optical ones lies in the possibility to avoid detector oversaturation related to the strong reflection of snow and ice. In 1997, the Canadian RADARSAT-1 satellite was rotated in orbit, so that its C-band (5.3 GHz frequency or 5.6 cm wavelength) synthetic aperture radar (SAR) antenna looked towards Antarctica. This permitted the first high-resolution (25 m) imaging of the entire continent since current high resolution civilian satellites in normal configuration cannot image south of 80° S due to their orbital path and imaging configuration. The image mosaic used in this work was obtained at the web site http://www.asf.alaska.edu and is characterised by a ground resolution of 125m. As well as showing the main features controlling the ice surface topography from few centimetres to kilometric scale, Radarsat mosaic also shows for the first time the existence of regional scale, subparallel linear features on the ice cap surface expressed on the image mosaic as sharp tonal variation and marked textural anisotropies. These intriguing linear features, characterised by lengths of some hundreds of kilometres and no more than 2-3 kilometres wide, develop unperturbed both on the East Antarctic Plateau and near the margins of the ice sheet. In this work we investigate the causes responsible for the formation and evolution of the regional scale lineaments detectable on the EAIS, specifically exploring both the exogenous and endogenous processes signatures on the ice surface patterns. Our results show that ice sheet dynamics coupled with bedrock morphologies is likely to be the most reasonable responsible for these puzzling features.