Left- and Right-Looking RADARSAT-2 Data for Mosaics of Ancient Supercontinents

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Abstract - **The Pangaea supercontinent began its break-up some 200 Ma ago, during which time the ancient cratons of West Africa and San Francisco-Congo of Gondwana were rifted apart. These older parts of the continental crust now reside in the African and South American Shields, but share a common geological past. Geological maps of reconstructed Pangaea aid geologists to understand the tectonic history of the evolving Earth, the global distribution of rock units and ore deposits. It follows that radar and other remotely sensed images of Earth can be mosaicked in the same fashion to provide supplementary information in support of such investigation.**

In our radar mosaic for part of Gondwana, left-looking RADARSAT-1 data of west Africa acquired on ascending passes during the Antarctic Mapping Mission and normal mode (right-looking) data of South America from descending passes were first seamed together separately. The two continental image maps were then rotated into their pre-break-up configuration to create a radar mosaic with a relatively consistent westward radar look. This critical aspect of the mosaic would not be possible from a SAR system without left- and right-looking capability. A consistent look direction is of great importance when landform interpretations are made. The left and right pointing of the RADARSAT-2 antenna will enable routine data collection of this kind for similar studies.

I. INTRODUCTION

A dual-look SAR imaging system proposed for RADARSAT-2 has several advantages over the current and former satellite SAR systems with a fixed look direction at one side. Both left and right antenna pointing capability along ascending or descending passes increases temporal coverage (critical for surveillance and disaster monitoring), but also offers data acquisition at one of four possible look directions for any location. Radar image mosaics are typically created from either ascending or descending pass data so as not to introduce adverse illumination effects between swaths.

This work describes the methodology for our unique radar reconstruction of part of Gondwana, a pre-Jurassic supercontinent (Fig. 1), and illustrates an application of combining right- and left-looking imagery for Earth science studies.

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Fig. 1. Gondwana during the Late Triassic.

II. Data Description

To achieve the radar mosaic of Gondwana, four left-looking ScanSAR Wide-B images of the western coast of Africa and five right-looking ScanSAR Wide-B images of the eastern coast of Brazil were used (Fig. 2). The African images were collected from ascending passes in an inverted acquisition mode configured for the Antarctic Mapping Mission (AMM) phase of RADARSAT-1 in October of 1997 [1]. The Brazilian data were acquired from descending passes in normal mode in July 2000. The production of the Gondwana mosaic with a consistent westward radar illumination direction was possible using each right- and left-looking set of ScanSAR images.

III. Methodology

All of the African ScanSAR images and a few of the Brazilian images were showing serious undesirable radiometric effects, which were attenuated using *Antenna Pattern Correction* techniques. To reduce radar speckle in the data, a 5x5 *Gamma* filter was applied on each image.

To improve the image fit and cartographic accuracy of the mosaic, all images were ortho-rectified using a 1-km DEM of the Africa and South America continents. The DEM was taken from the Global Land One-Kilometre Base Elevation (GLOBE) project (www.ngdc.noaa.gov/seg/topo/gltiles.shtml). The Ground Control Points (GCPs) required for the ortho-rectification were collected from international 1: 1 000 000 topographic maps along with Digital Chart of the World (DCW) coast line and inland hydrologic vectors. Those data sources were considered practical and adequate to produce the desired small-scale RADARSAT-1 mosaic [2].

The OrthoEngine Satellite Edition™ software from PCI Geomatics (version 7.0 for Linux) was used to conduct the ortho-rectification and mosaicking work of the images for each side of the Atlantic. The ortho-rectification software is based on SRIT, an algorithm employing geometrical modelling of the satellite orbit with ortho-rectification technique [3].

Each ortho-rectified mosaic was set to a WGS84 geographic projection with an output pixel spacing equivalent to the one of the original ScanSAR Wide-B images (50m). Then, the two mosaics were assembled together according to the best possible fit of the continental margins. Figure 3 illustrates the re-assembly of Gondwana made of the mosaicked RADARSAT-1 images and a consistent westward radar look direction.

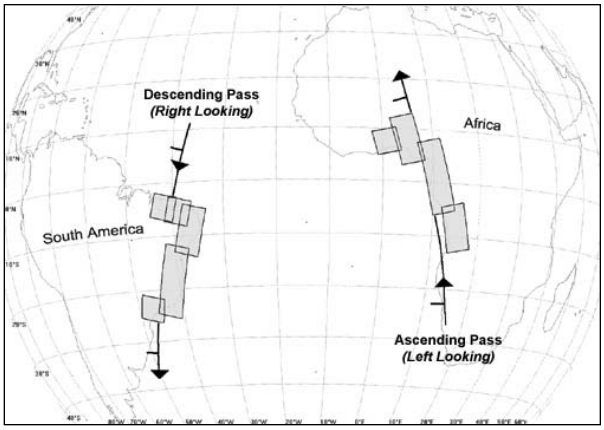

Fig. 2. Distribution of the right-looking Brazilian and left-looking African ScanSAR images.

IV. Discussion

Without left-looking data for the African continent, right-looking data rotated the required *ca*. 30 degrees would create a mosaic with South America whose look-direction abruptly changes by over 40 degrees. This illumination difference across the continental seam would make correlations of structures between the two regions much more difficult. Because of these problems, composite mosaics of former continental terranes, are unlikely to be constructed unless a relatively consistent radar look-direction is obtained for the mosaic. The additional look directions offered by a dual look SAR system offers greater possibility that the appropriate look direction can be chosen.

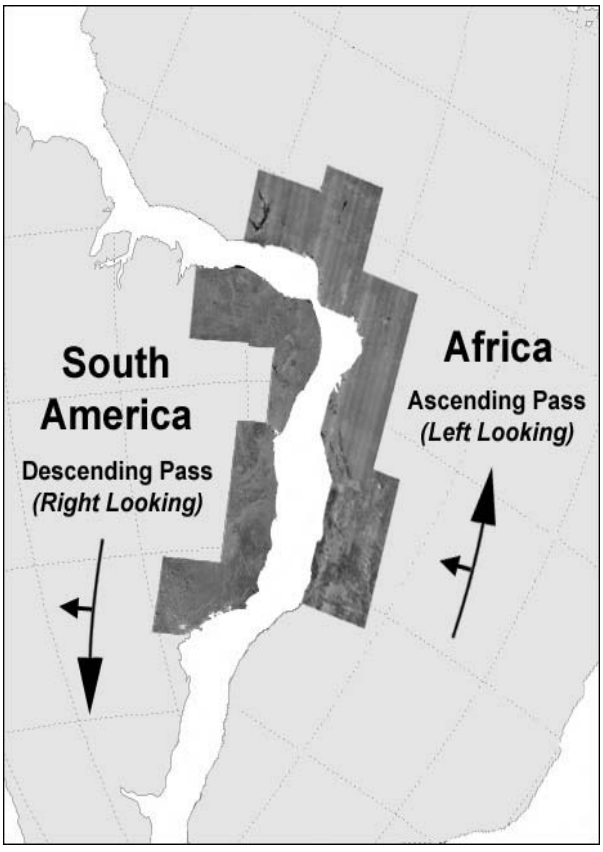

Fig. 3. Gondwana re-assembly using mosaicked RADARSAT-1 images of consistent westward radar illumination direction.

V. Conclusions

Our Gondwana mosaic study illustrates the value of a dual-look radar imaging system, as proposed for RADARSAT-2. Judicious selection of left- and right-looking image scenes permits a new class of image mosaic. The main characteristics of this mosaic are that geographically isolated regions of Earth are imaged and re-assembled to their ancient configuration and this mosaic preserves a consistent radar look-direction. These SAR mosaics can be used to investigate many trans-continental geologic structures in their pre-break-up origins. Information derived from Gondwana, Laurentia, Rodinia, or other supercontinent mosaics can play an important role for tectonic studies and in modelling resource deposits.

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