Lithospheric thickness and principal crustal lineaments of southern Algeria: attempt to locate diamondiferous magmatic primary sources

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In Algeria, more than 1500 alluvial diamonds were found; however in the absence of evidence of the primary source, their provenance remains enigmatic. This study aims to test a model of detection of potentially fertile areas in diamondiferous kimberlites defined by Faure et al. (2004) for the North American Craton. They are: (i) cold and thick lithosphere (175-275 km), (ii) steep slope, (iii) abrupt direction change in mantle morphology.

Thus, several works on geometry and thickness of African lithosphere are obtained thanks to gravity anomalies derived mainly from satellite data, or by regional scale seismic tomography. We compared the results of Faure et al. (2004) with some other models, such those of Artemieva and Mooney (2001) or Artemieva (2006) and Braitenberg (2014), showing the thickness of the lithosphere under the West African Craton (WAC) and the neighbouring south Algerian regions.

Compiling the different results allowed us to identify the areas that best match the geologic conditions and models previously mentioned. In addition, mapping of the most important south Algerian crustal lineaments obtained by inversion of aeromagnetic and gravity data, shows that the large lithospheric faults are within the range of targeted regions.

Most lithospheric thickness models defined for the WAC show that southern Algeria filled the three main conditions established by Faure's model. For example, this study reveals many favourable zones, such as the southern part of Touat region, which gathers all the conditions to be the seat of a deep magmatic activity which may produce diamondiferous rocks.

In addition, the kimberlites are often associated with structural trans-lithospheric corridors (Jelsma, 2009), which is also considered as a condition leading to ascent of diamonds to the surface (Kaminsky, 1992). So, we mapped the most important southwest Algerian crustal lineaments by inversion of aeromagnetic and gravity data. The results show the presence of large lithospheric faults in the targeted regions.

The region hosts numerous mafic dyke swarms. We mapped them using various datasets such as full resolution Google Earth™ images, multispectral Landsat 8 Operational Land Imager (OLI) and aeromagnetic data. The spectral response of Landsat Oli 8 allowed the discrimination of the felsic and the potentially diamondiferous mafic dykes. A statistical analysis helped to establish a distribution dykes map which reveals a central concentration of mafic dykes trending N-S and NW-SE, the NE-SW trend comprises a second order orientation with a smaller size.

In addition to confirm the possibility of getting diamondiferous primary sources in southern Algeria, we believe that these preliminary results will also help in the choice of areas to be further explored.

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