

8. CONCLUSION

Applying GIS as a tool in structural analysis of the Bushveld Complex and surrounding areas, proved to be successful. A functional structural database was created, and the orientations of structures can be represented by rose diagrams created in ArcView 3.2 GIS. Meaningful stress analyses of the rose diagrams were made and by combining other structural and tectonic information obtained from the literature, possible stress fields during the tectonic history of the Bushveld Complex and surrounding areas were obtained. This chapter evaluates the effectiveness of the methods employed during this study as well as discuss some conclusive observations about the structural history of the Bushveld Complex.

The methods employed and the data obtained during this study proved that GIS can be used as an effective means of evaluating large amounts of geological data. Therefore, any regional-scale structural study can benefit from the use of GIS techniques. In addition, this new technique provides a fast method for determining the orientations of lines and representing these orientations by means of rose diagrams. By merely clicking consecutively on the various customized icons in the ArcView program the desired results are produced. By using the structural database in conjunction with analytical techniques of ArcView, different criteria (type, age, displacement type etc.) can be specified by which structures are considered.

The main shortcoming of applying an automated technique such as this, is the computer assigned ages for the structures. Ages are assigned based on cross-cutting relationships which provide a maximum age for a structure. The possibility remains that a structure could have been a pre-existing plane of weakness, or could have reactivated during later stages. The GIS assigned ages might not always be correct and it is therefore important to incorporate ages obtained from geological field evidence, as well as consider reactivation ages.

The main shortcomings of the analytical techniques used during this study, result from considering the map exposure of a structure as its true orientation. This might result in erroneous interpretations of stress directions especially for low-angle structures in areas of high relief. Also, most stress directions are interpreted assuming the structures are primary and not the result of reactivation of planes of pre-existing weaknesses. Again, erroneous interpretations of stress directions might

result, since oblique stresses can cause reactivation of a plane of pre-existing weakness.

For a study such as this, the quality of the data is of utmost importance. The structural database for the Bushveld Complex and surrounding areas is far from complete. Much more detailed structural field work is necessary especially on the large faults of the eastern Bushveld Complex (Wonderkop, Steelpoort, Laersdrif faults). Without knowing the timing, reactivation histories, type, and sense of displacement of these faults, the deformational history of the Bushveld Complex will remain enigmatic. However, this study allowed for the consideration of various possibilities regarding the timing, displacement and possible tectonic causes for the structures. Detailed structural data will place more constraints on the interpretation of the data and, will further result in better tectonic models. Nevertheless, despite of the deficiencies in structural information the following conclusive observations are made:

- Structures, such as dykes, lineaments, faults and folds, in and around the Bushveld Complex reflect a definite NE and NW structural trend. It is possible that these directions were established early in the tectonic evolution of the Kaapvaal Craton, and served as planes of pre-existing weakness during later deformation of the Craton.
- It is evident that NE and NW stress directions were constantly reutilized, and the identities of the principal stress directions alternated between these NE and NW orientations during the structural history of the area. However, the only variation to this occurs during post-Waterberg times when prominent NS stress directions prevailed. However, during post-Karoo times the characteristically NE and NW directions reoccurred.
- Most of the stress fields obtained for the various time periods are consistent with constant reactivation of the TML. Left-lateral, right-lateral, thrust and normal movements are known to have occurred at various times along the TML during the history of the Bushveld Complex and surrounding areas.
- On a regional scale, the Transvaal basin and Bushveld Complex seem to have been subjected to the same deformation. However, the Transvaal Basin appears to have been deformed mildly to intensely in localized areas before the intrusion of the Bushveld Complex.