

**A GIS-BASED STRUCTURAL ANALYSIS OF THE BUSHVELD COMPLEX AND  
SURROUNDING AREAS**

by

**RENEÉ M. GREYVENSTEYN**

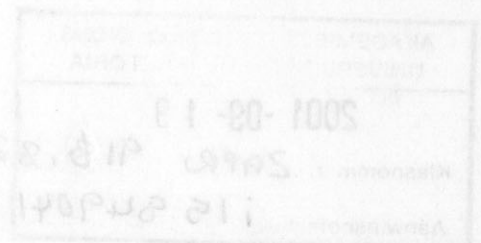
**Submitted in partial fulfillment of the requirements for the degree**

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**in the Faculty of Natural and Agricultural Sciences  
University of Pretoria**

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**ABSTRACT**

GIS (Geographic Information Systems) techniques were successfully applied as a tool in structural analysis of the Bushveld Complex and surrounding areas. An existing digital geological database, BOSGIS, was used as basis of this study. A GIS structural database, based on a literature study, was created using the program ArcView 3.2 GIS. In addition, the program was customized to calculate the orientations of the structural lines (faults, folds, dykes and lineaments) in BOSGIS, and to represent these orientations by rose diagrams. Also, by using ArcView's analytical capabilities, ages or structural domains were assigned to these structures.

Stress analysis was done in order to obtain an understanding of the stress fields influencing the formation and subsequent deformation of the Bushveld Complex and surrounding areas. Five main geological time periods are considered: pre-Transvaal, post-Transvaal/pre-Bushveld, post-Bushveld/pre-Waterberg, post-Waterberg/pre-Karoo, Pilanesberg and post-Karoo. Based on the structural information gained from the literature study the directions of the possible stresses responsible for producing these structures, are derived.

The study found that structures, such as dykes, lineaments, faults and folds, in and around the Bushveld Complex reflect a definite NE and NW structural trend. It is also evident that NE and NW stress directions were constantly reutilized, and during the structural history of the area the identities of the principal stress directions alternated between the NE and NW orientations. The only variation to this occurs during post-Waterberg times, when prominent NS stress directions prevailed. However, during post-Karoo times the characteristic NE and NW directions reoccurred. The derived stress fields are consistent with constant reactivation of the Thabazimbi-Murchison-Lineament (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.



## SAMEVATTING

GIS (Geografiese Inligting Stelsels) tegnieke was met sukses toegepas in 'n strukturele analise van die Bosveldkompleks. 'n Bestaande digitale geologiese databasis, BOSGIS, was gebruik as basis gedurende die studie. Met behulp van die program ArcView 3.2 GIS wass 'n GIS strukturele databasis ontwerp gebaseer op 'n literatuurstudie. Daarby was die program aangepas om die orientasies van strukturele lyne (verskuiwings, plooië, gange en lineamente) in BOSGIS te bereken. ArcView se analitiese vermoëns was gebruik om ouderdomme en strukturele gebiedens toe te ken aan die strukture.

Spannings analise was gedoen om insig te verkry in die spanningsvelde wat die formasie en daaropvolgende deformasie van die Bosveldkompleks en die omliggende areas beïnvloed het. Vyf hoof geologiese tydperke was oorweeg: voor-Transvaal, na-Transvaal/voor-Bosveld, na-Bosveld/voor-Waterberg, Pilanesberg, na-Waterberg/voor-Karoo. Die orientasies van die moontlike spannings wat verantwoordelik was vir die vorming van die strukture was afgelei uit inligting verwerf uit die literatuurstudie.

Die studie het bevind dat strukture soos gange, lineamente, verskuiwings en plooië in en om die Bosveldkompleks en omliggende gebiede 'n definitiewe NW en NO strukturele neiging toon. Dit is ook opsigtelik dat NW en NO spanningsrigtings gedurig herbenut was, en dat gedurende die strukturele geskiedenis van die area die identiteite van die hoofspanningsrigtings gewissel het tussen NO en NW. Die enigste afwyking hiervan kom voor tydens die na-Waterberg tydperk, toe prominente NS spanningsrigtings geheers het. Die afgeleide spanningsvelde was konsekwent met voortdurende heraktifisering van die Thabazimbi-Murchison-Lineament (TML). Links-laterale, regs-laterale, op en normaal beweging het plaasgevind langs die TML gedurende verskillende tye in die geskiedenis van die Bosveldkompleks en omliggende gebiede.

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