

# OUT OF AFRICA CONFERENCE

140 years with Kevin Burke and Lew Ashwel

## THE PALAEOPROTEROZOIC TRANSVAALIDE OROGENIC BELT

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Roger Gibson, Paul Alexandre



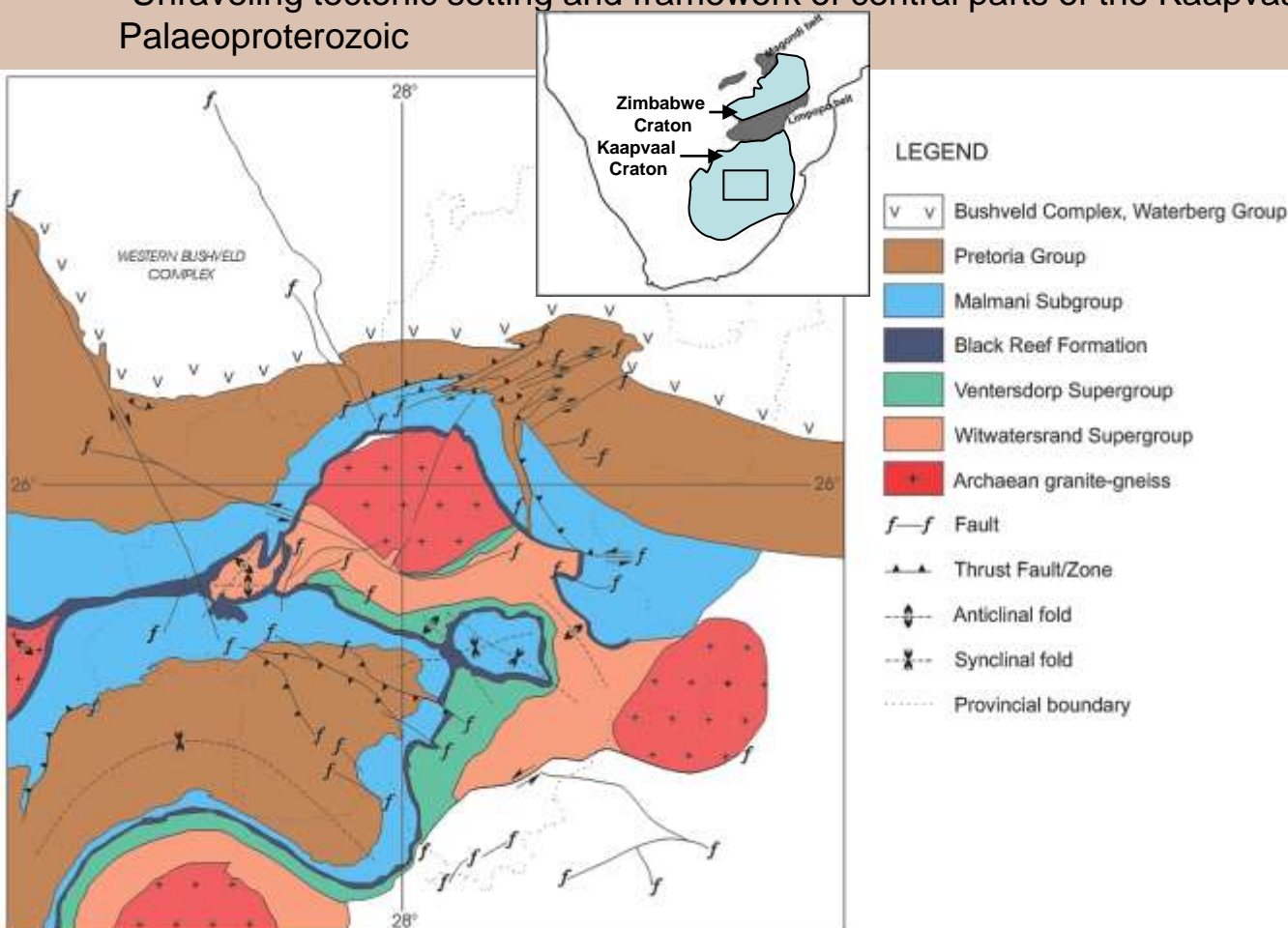
Council for Geoscience

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# THE TRANSVAALIDE OROGENIC BELT: INTRODUCTION

## PROJECT DEFINITION

- Aims to study deformation and metamorphism of a poorly understood orogenic belt (Ph.D Wits)
  - *Transvaalide fold-and-thrust belt* (Andreoli 1986)
  - Type area located between Johannesburg Dome and Bushveld Complex
- Study area located mainly between the Bushveld Complex and Vredefort Impact Structure
  - Unraveling tectonic setting and framework of central parts of the Kaapvaal craton during Palaeoproterozoic



## HISTORY

Polyphasic low grade to greenschist metamorphism and brittle to ductile deformation with pervasive thrusts define enigmatic Transvaalides fold belt of obscure age (Andreoli 1988)

Extensive Transvaalide fold-and-thrust belt along margins of Kaapvaal craton that clearly is distinct (~2.04 Ga) from emplacement age of Bushveld Complex (~2.06 Ga) and from Vredefort impact event (~2.02 Ga) (Alexandre et al. 2006)



# THE TRANSVAALIDE OROGENIC BELT: INTRODUCTION

## IMPORTANCE

- Historical explanation for deformation
  - contact metamorphism, Vredefort dome
  - N-verging compressional (ductile structures) features (McCarty et al. 1986, Gibson et al. 1999)
  - extensional (brittle structures) features with inward vergence at margins of impact craters
- Study area between globally important Bushveld Complex intrusion (ca. 2060 Ma) and Vredefort impact (2020 Ma) events
- Increase scientific knowledge of unique period in South African geology not developed well elsewhere in the world
- Economically important deposits (platinum & gold)
- International tourism attractions - holistic management
- Water ingress
- Geological hazards



# THE TRANSVAALIDE OROGENIC BELT: STRUCTURES

## STRUCTURES

- Ductile: small- to medium-scale folds, cleavages, monoclines & thrust planes, slates, phyllites
- $D_1 = 2042 \text{ Ma}$  (Alexandre et al. 2006)



# THE TRANSVAALIDE OROGENIC BELT: AGES

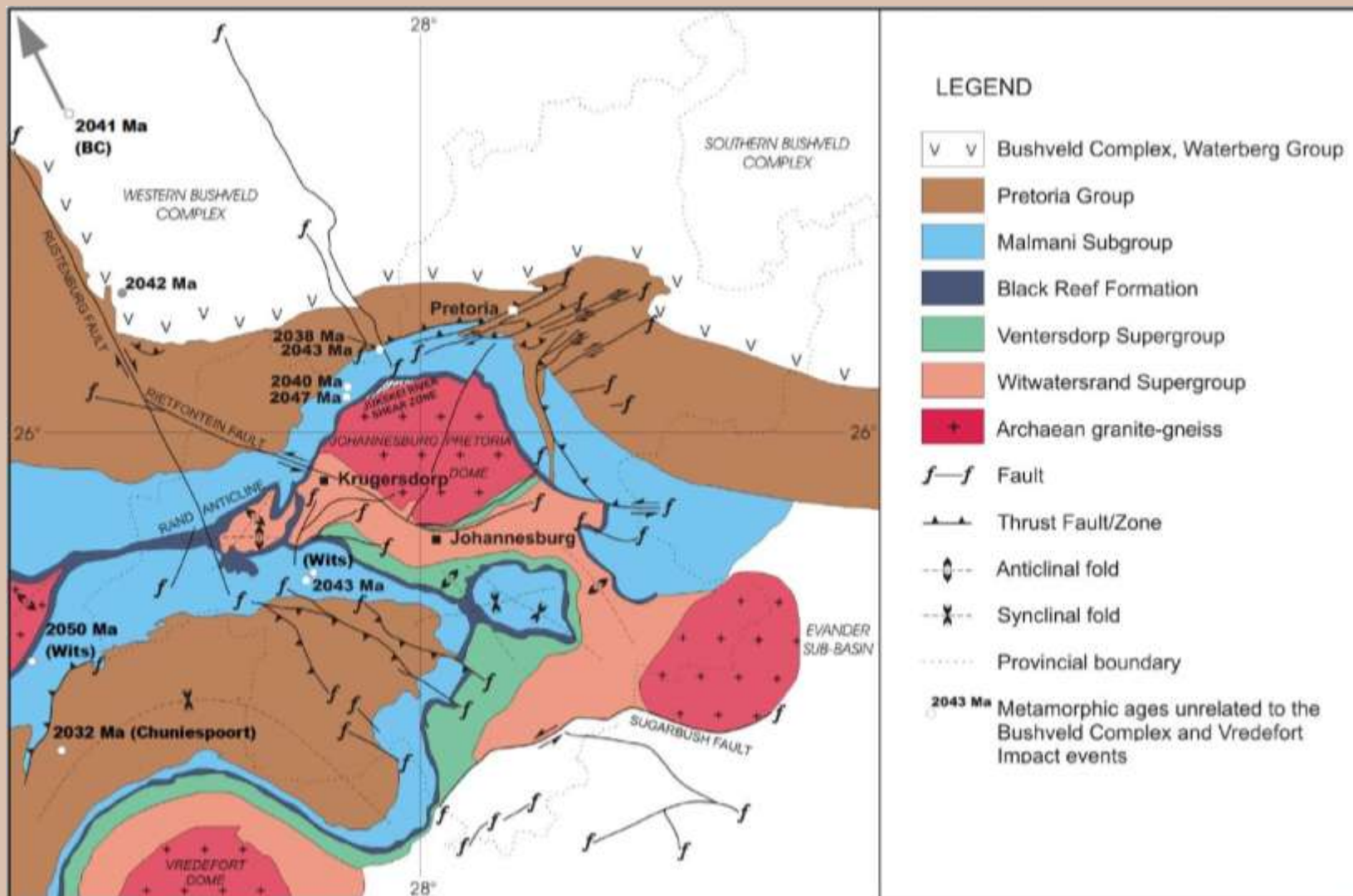
## PUBLISHED METAMORPHIC GEOCHRONOLOGY DATA

Age (Ma)	Unit(-s) Dated	Dating Method	Nature of Events	Reference
2032 ± 5	Chuniespoort Group	SHRIMP <sup>207</sup> Pb/ <sup>206</sup> Pb weighted mean age on xenotime	Age of metamorphic xenotime	Rasmussen et al. 2007
2041 ± 3	Rustenburg Layered Suite: Critical Zone, MG-1 chromite	Mass Analyzer Products MS <sup>40</sup> Ar/ <sup>39</sup> Ar weighted mean plateau age on plagioclase and biotite (2045 ± 5, 2040 ± 9, 2038 ± 6, 2034 ± 6, 2042 ± 2)	Post-magmatic age of micas in MG-1 chromite layer	Cassata et al. 2009
2042 ± 3	Pretoria & Chuniespoort Groups	Mass Analyzer Products MS <sup>40</sup> Ar/ <sup>39</sup> Ar weighted average age on white mica (2038 ± 6, 2040 ± 5, 2043 ± 8, 2047 ± 7)	Synkinematic age of micas, polyphase folding, thrusting, low grade metamorphism (Kaaopvaal Craton marginal orogenesis)	Alexandre et al. 2006
2042 ± 3	Rustenburg Layered Suite: Upper Critical Zone, UG2 chromitite	Laser Ablation Gas Chromatograph MS <sup>40</sup> Ar/ <sup>39</sup> Ar weighted mean plateau age on biotite (2037 ± 8, 2040 ± 9, 2042 ± 8, 2045 ± 8, 2045 ± 9, 2045 ± 9, 2049 ± 10)	Post-magmatic age of micas in UG2 seam	Nomade et al. 2004
2043 ± 5	Central Rand Group: Elsberg Formation	SHRIMP <sup>207</sup> Pb/ <sup>206</sup> Pb weighted mean age on monazite	Age of metamorphic monazite intergrown with gold in quartz-pebble conglomerate	Rasmussen et al. 2007
2043 ± 7	Central Rand Group: Krugersdorp Formation	SHRIMP <sup>207</sup> Pb/ <sup>206</sup> Pb weighted mean age on monazite	Age of metamorphic monazite in shale	Rasmussen et al. 2007
2050 ± 8	West Rand Group: Parktown Formation	SHRIMP <sup>207</sup> Pb/ <sup>206</sup> Pb weighted mean age on xenotime	Age of metamorphic xenotime	Rasmussen et al. 2007 Kositcin et al. 2003

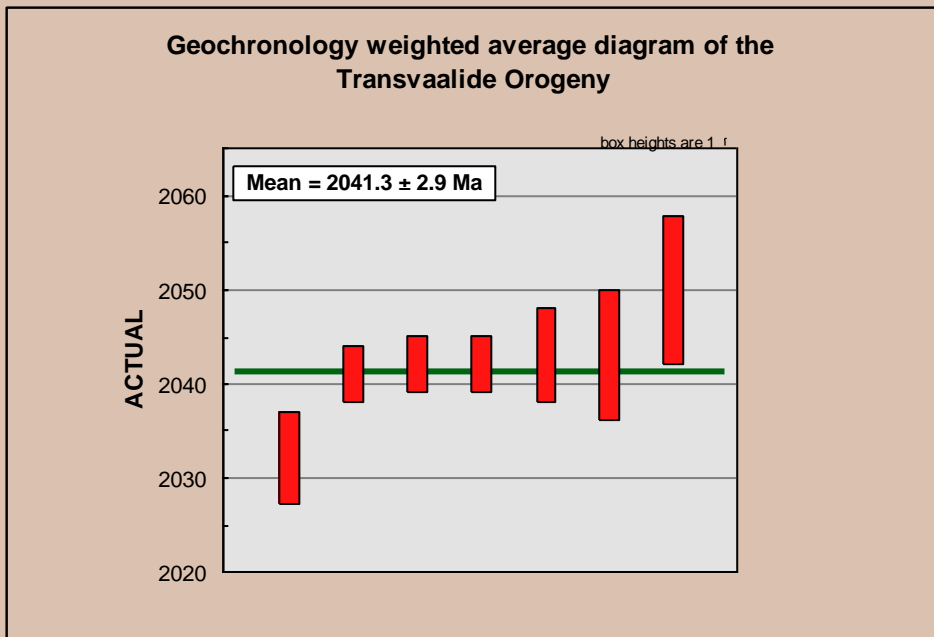
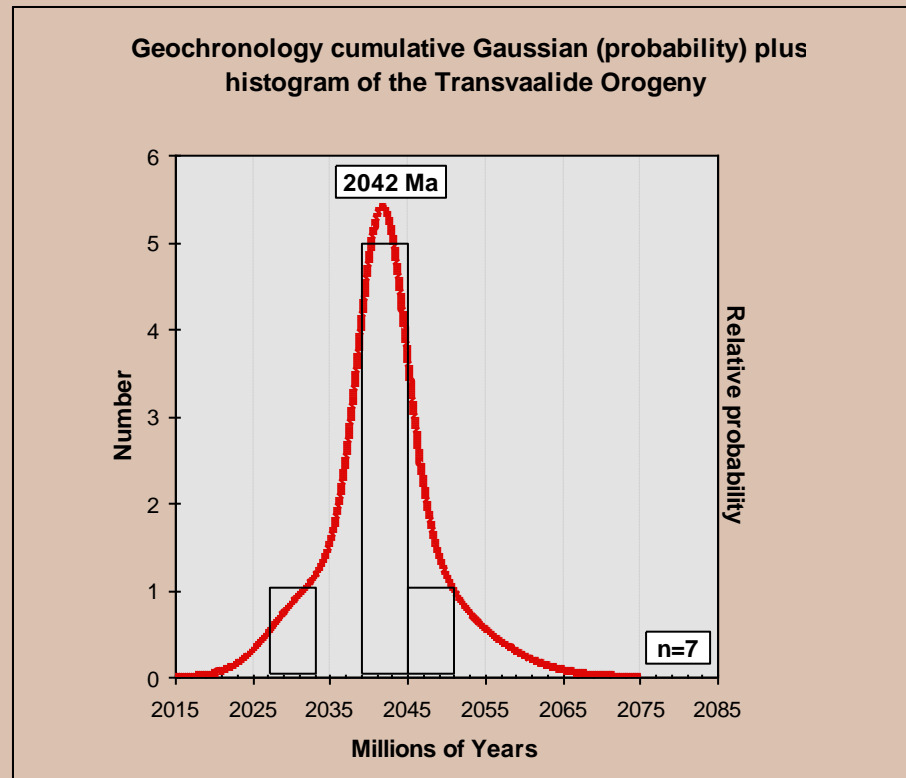
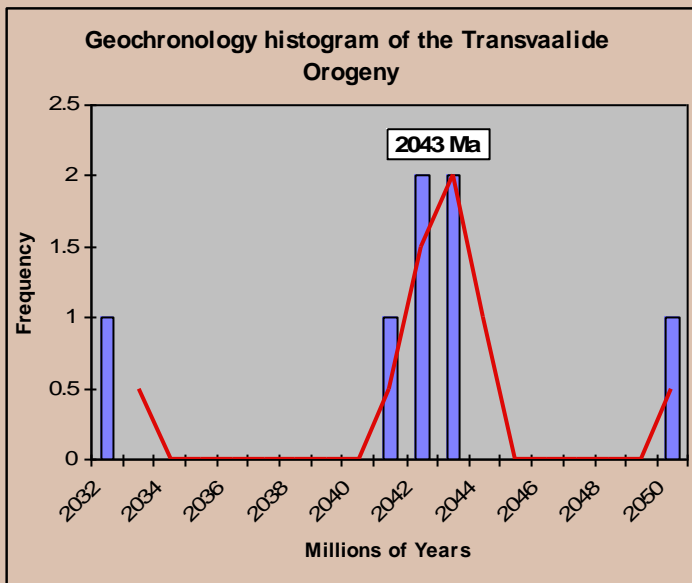


# THE TRANSVAALIDE OROGENIC BELT: STRUCTURES

## PUBLISHED METAMORPHIC GEOCHRONOLOGY DATA

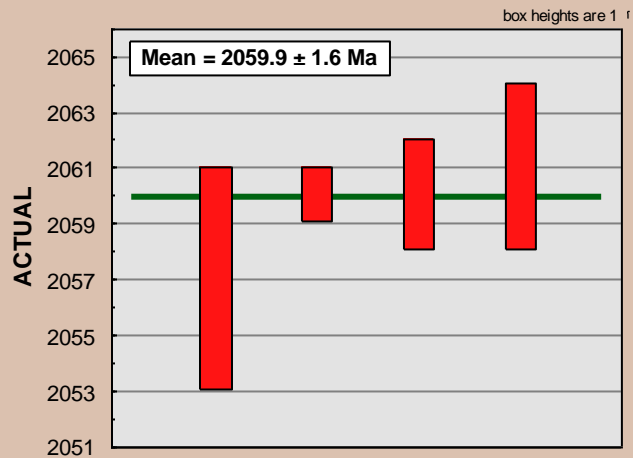


# GEOCHRONOLOGY OF THE TRANSVAALIDE OROGENY

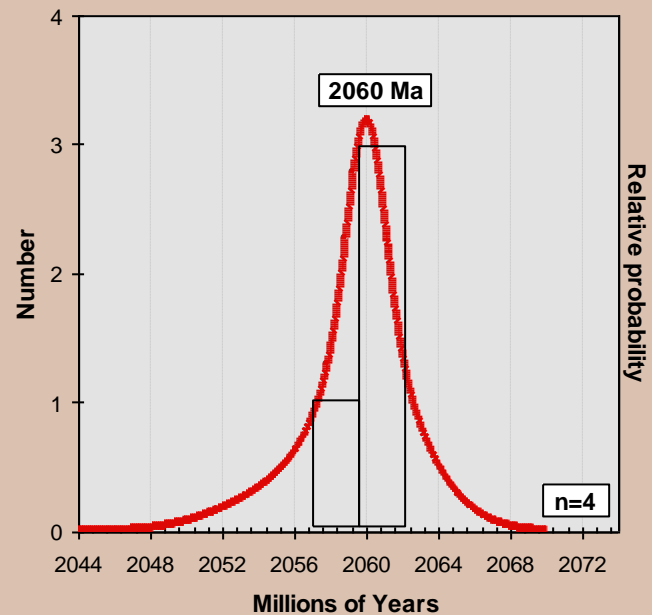


# GEOCHRONOLOGY OF THE ROOIBERG GROUP

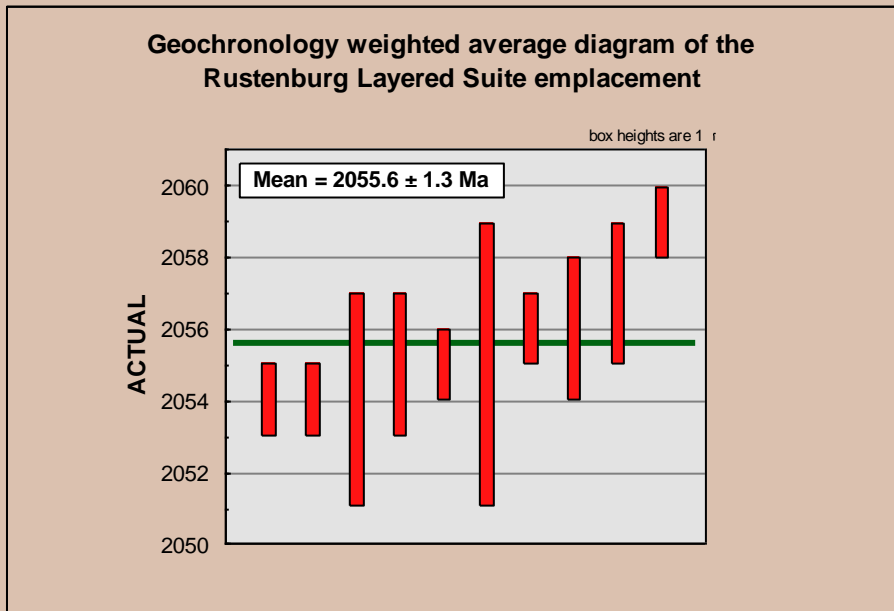
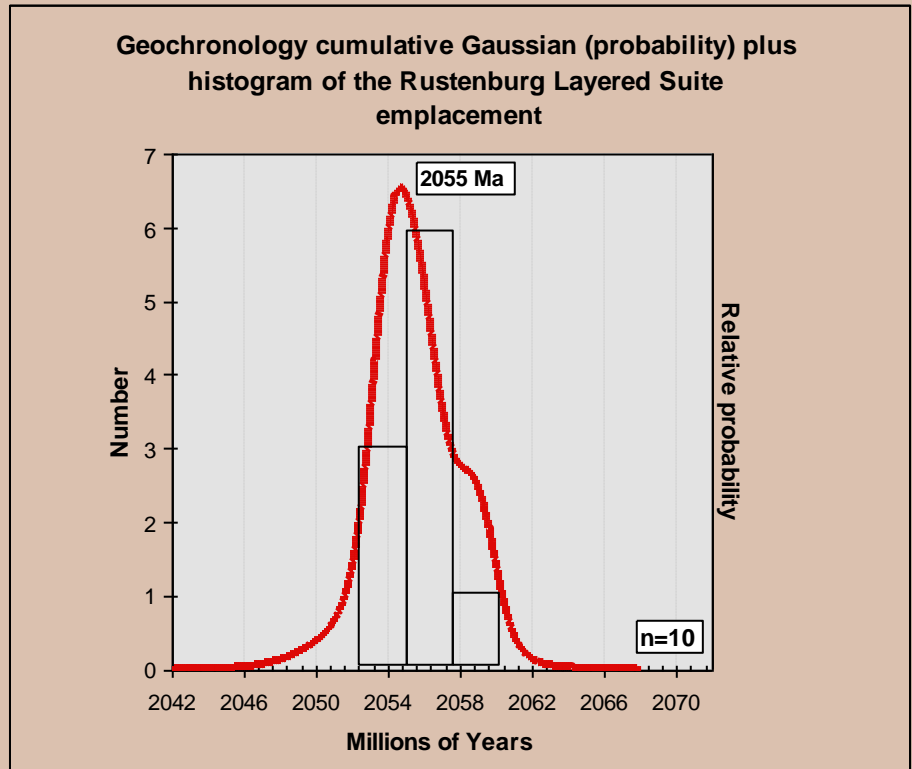
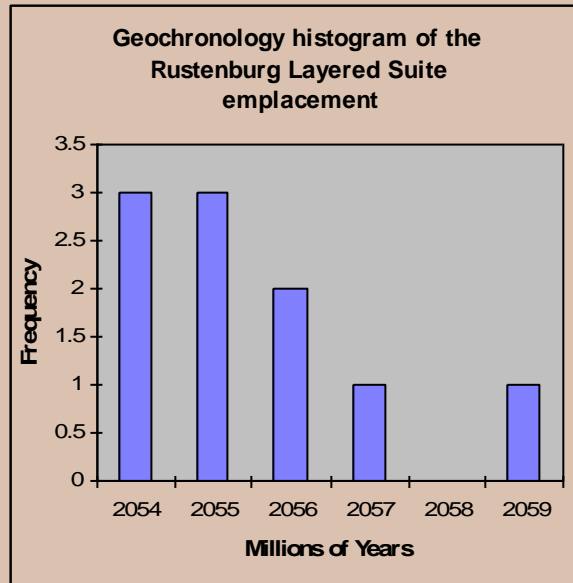
Geochronology weighted average diagram of the Rooiberg Group emplacement



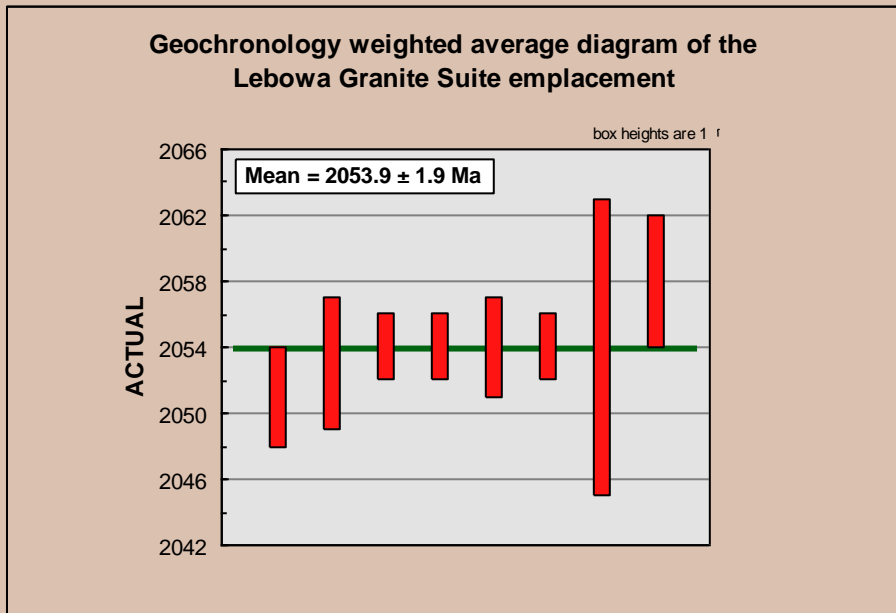
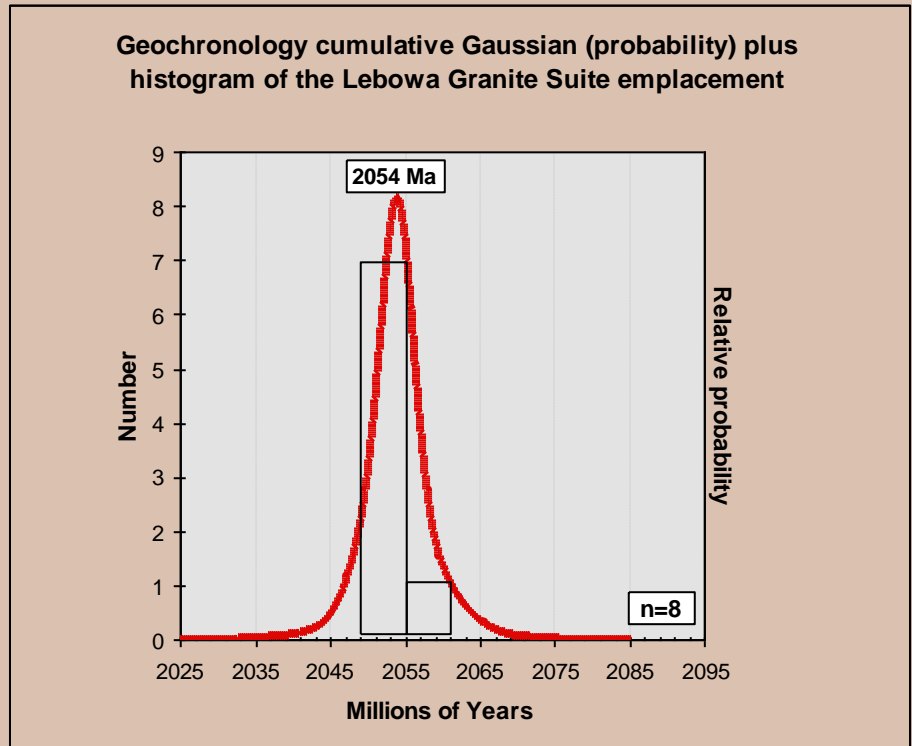
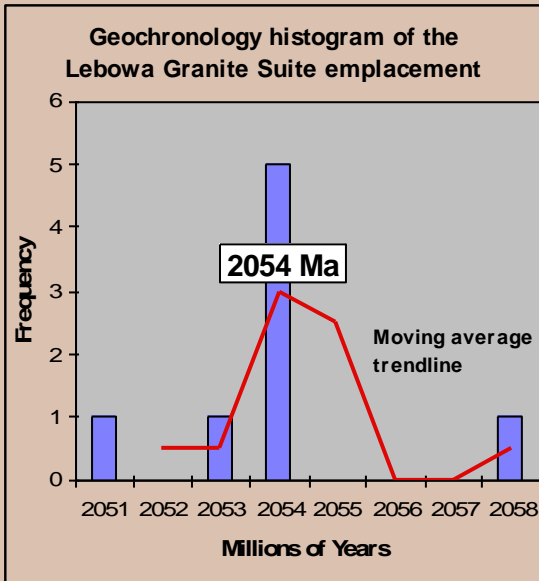
Geochronology cumulative Gaussian (probability) plus histogram of the Rooiberg Group emplacement



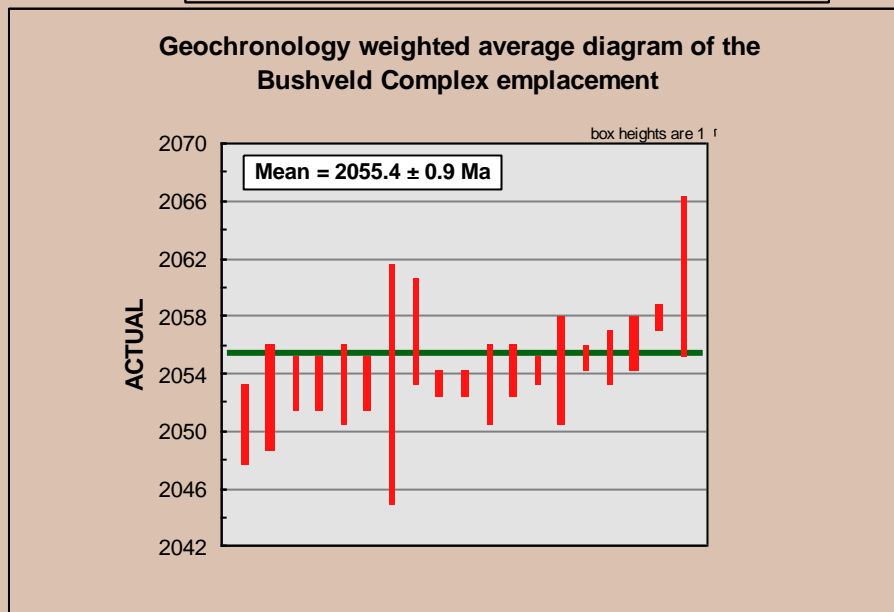
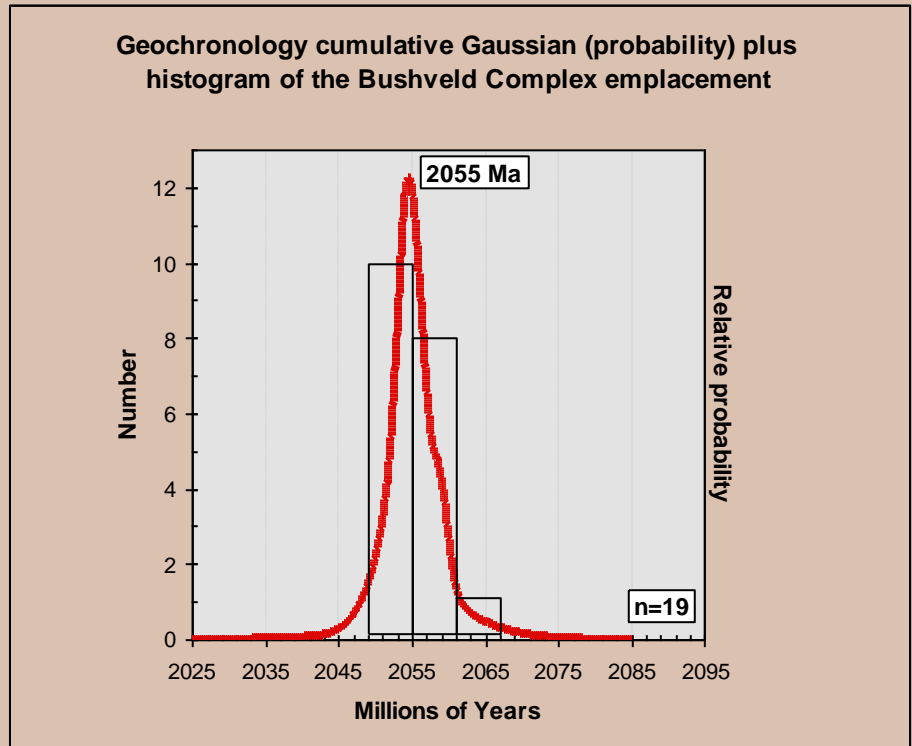
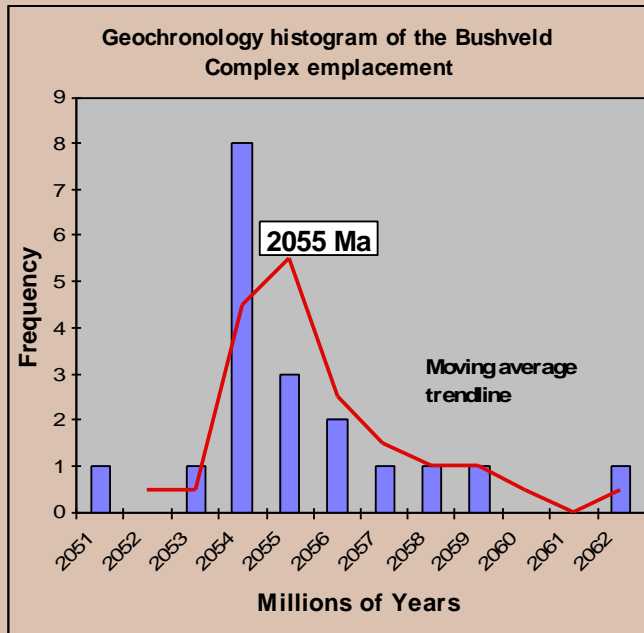
# GEOCHRONOLOGY OF THE RUSTENBURG LAYERED SUITE



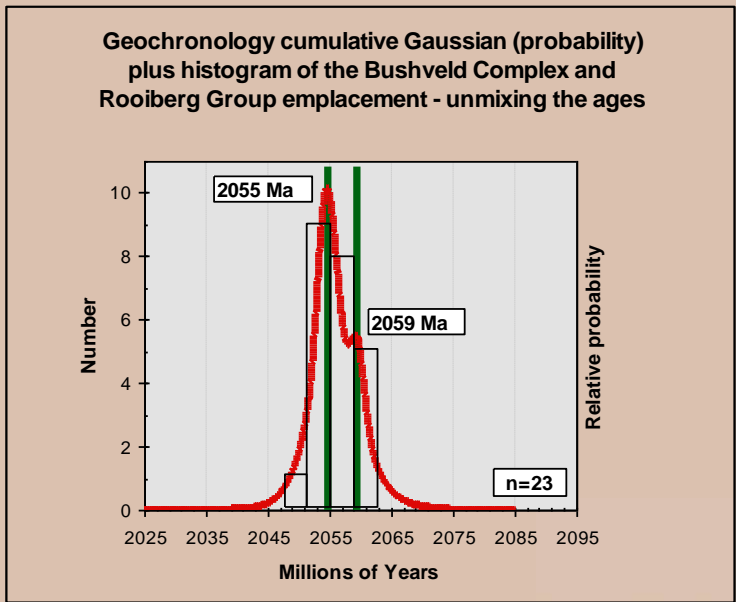
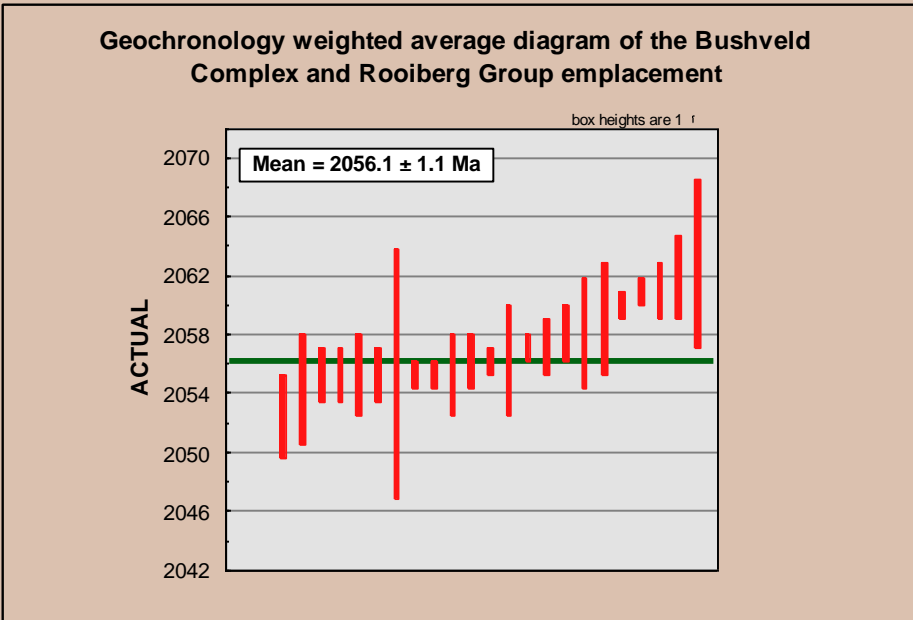
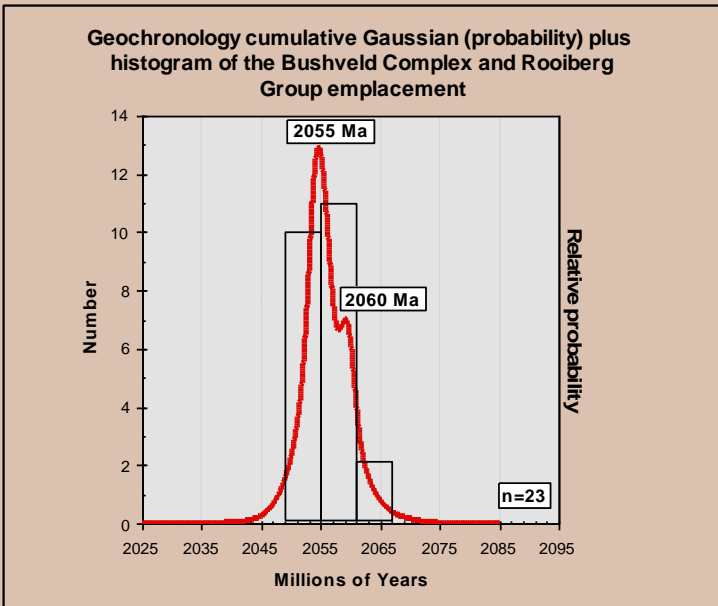
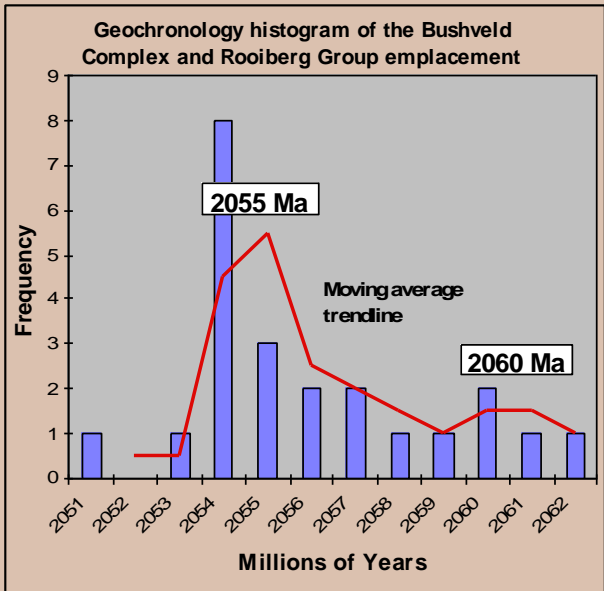
# GEOCHRONOLOGY OF THE LEBOWA GRANITE SUITE



# GEOCHRONOLOGY OF THE BUSHVELD COMPLEX

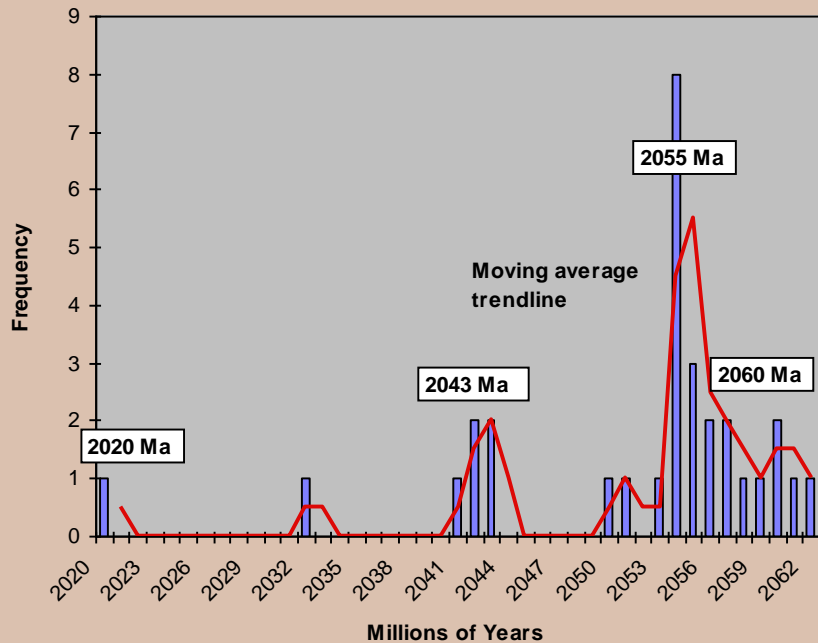


# GEOCHRONOLOGY OF THE BUSHVELD COMPLEX & ROOIBERG GROUP

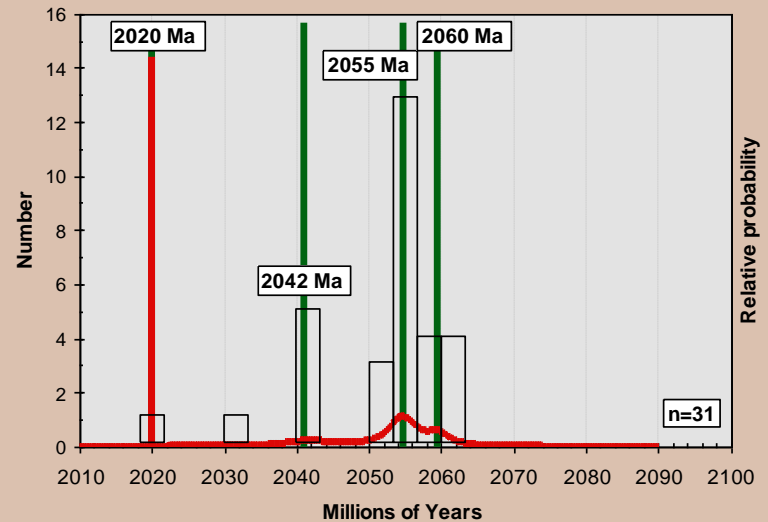


# GEOCHRONOLOGY OF THE CENTRAL KAAPVAAL CRATON

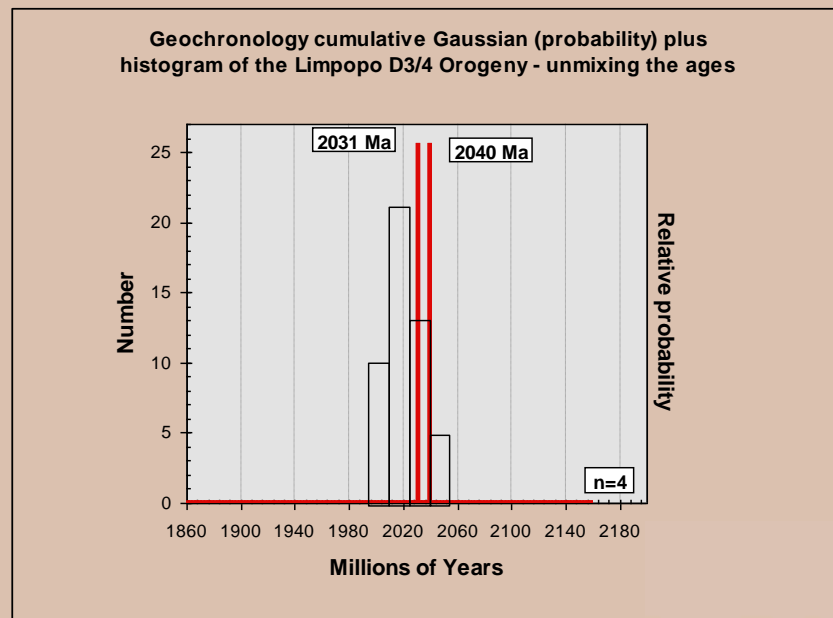
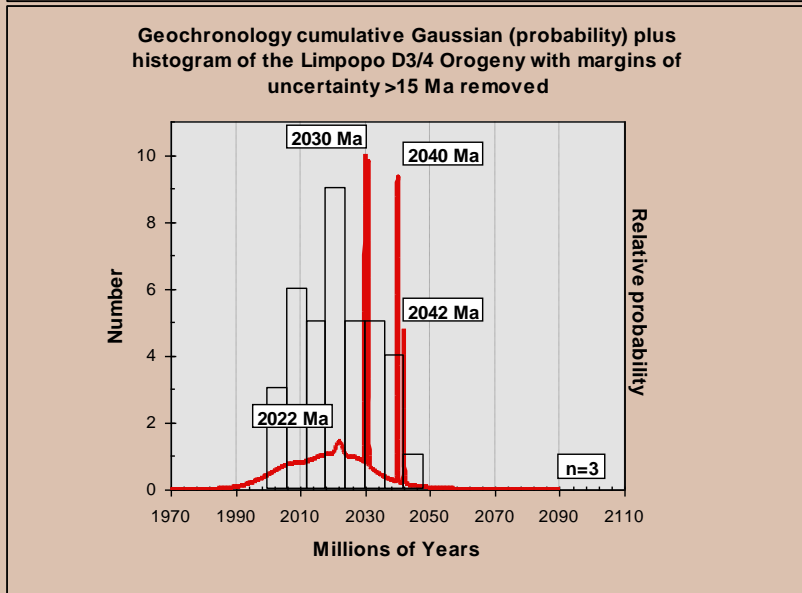
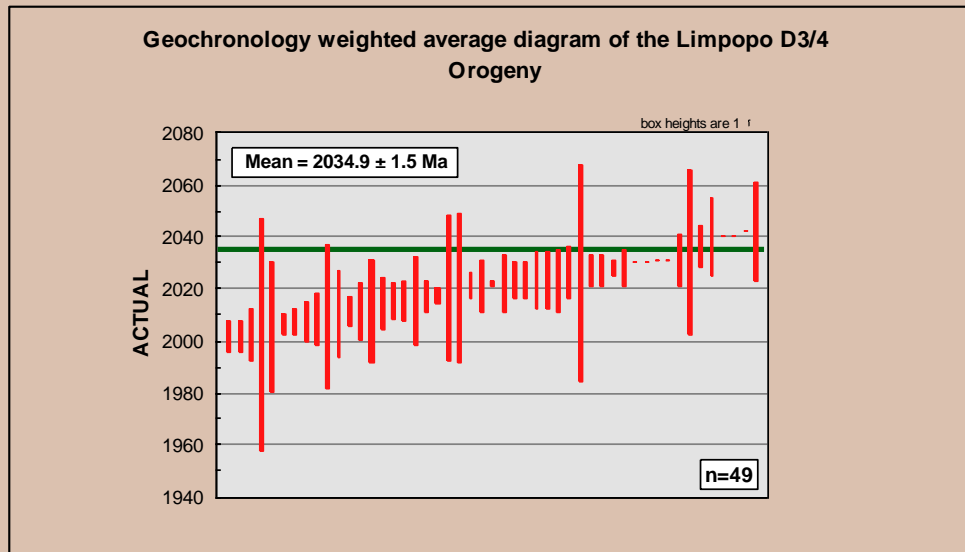
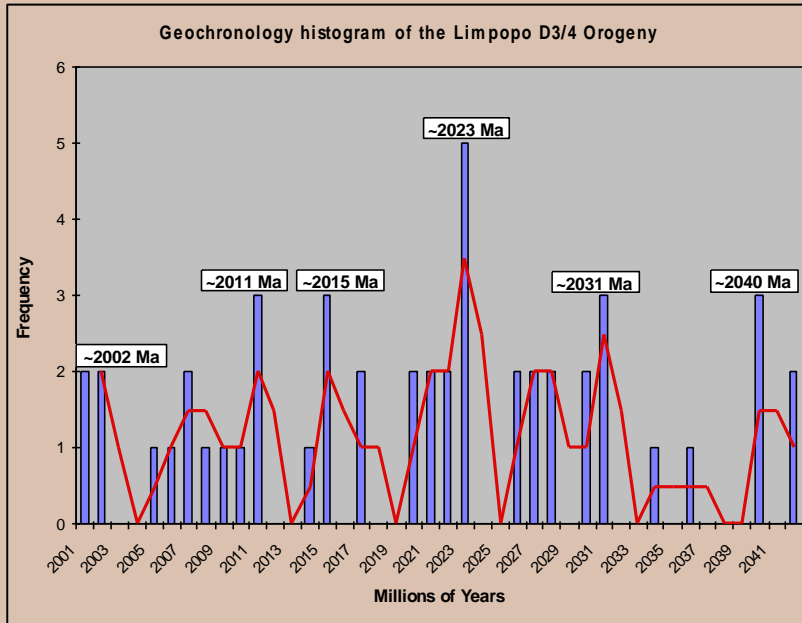
Geochronology histogram of the Rooiberg Group, Bushveld Complex, Transvaalide Orogeny and Vredefort Impact Event



Geochronology cumulative Gaussian (probability) plus histogram of the Rooiberg Group, Bushveld Complex, Transvaalide Orogeny and Vredefort Impact Event

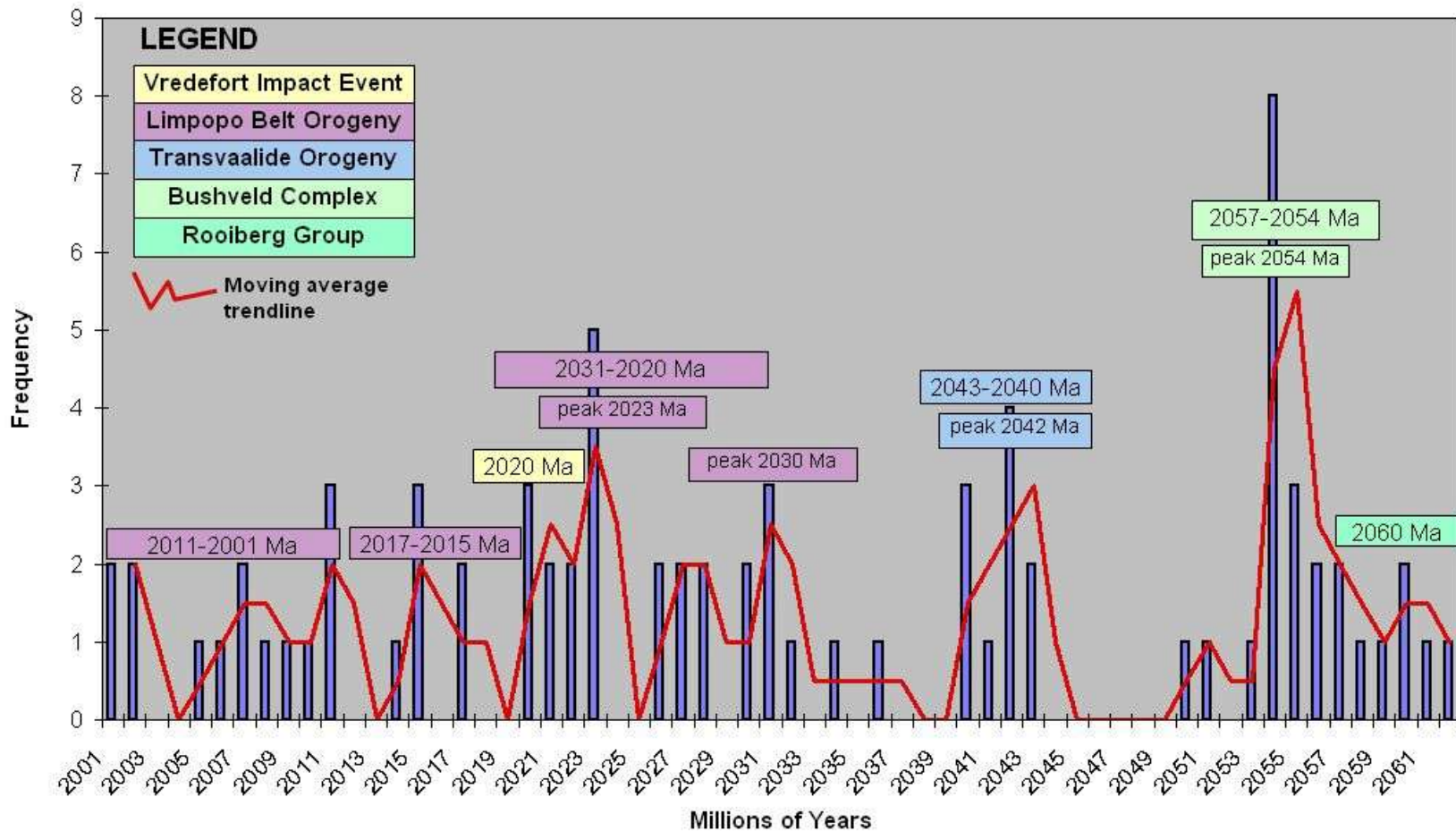


# GEOCHRONOLOGY OF THE LIMPOPO D3/4 OROGENY



# GEOCHRONOLOGY OF THE CENTRAL-NORTHERN KAAPVAAL CRATON

**Geochronology histogram of the Rooiberg Group, Bushveld Complex, Transvaalide and Limpopo D3/4 Orogeny and Vredefort Impact Event**



**END**

**THANK YOU !**

