

Granitos



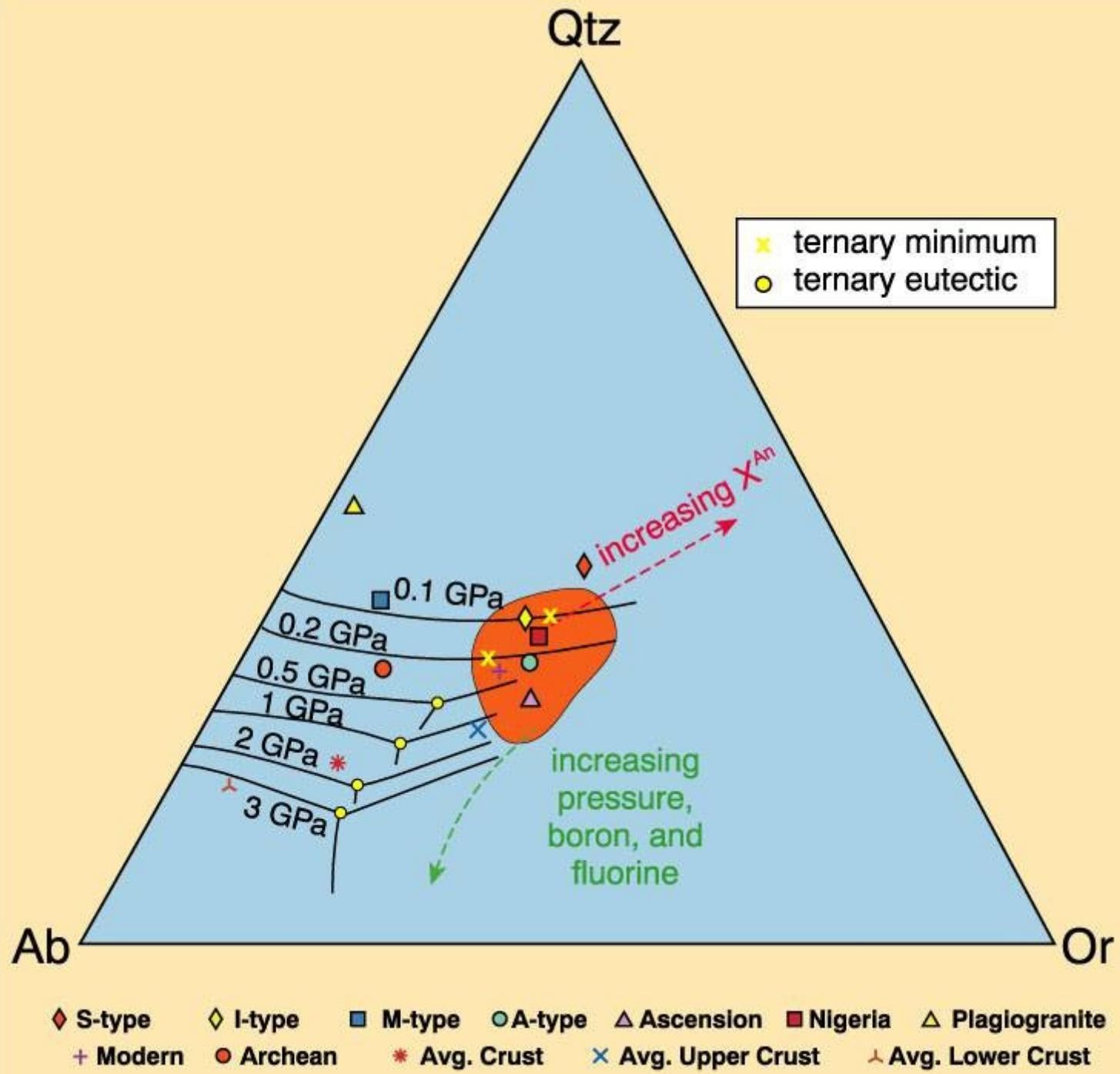
Francisco Gutiérrez

Granitos

- Rocas ígneas félasicas intrusivas
- Textura de grano medio a grueso
- Forman torres y masivos con depresiones formadas por la aureola de contacto hornfels.
- Generalmente:
 - Masivo (s/ estructura interna)
 - Duro
 - Densidad baja ~ 2.75 g/cm³
 - Viscosidad alta ~ $4.5 \cdot 10^{19}$ Pa·s
- Latin *granum*, un grano de la roca cristalina
- Equivalente a la riolita
- Mala permeabilidad primaria, buena secundaria

Química

- Granitoides son el componente terrestre más común.
- Han cristalizado de magmas a T cercanas a el eutectico (T mínima de una curva cotectica).
- Evolucionan del eutectico por diferenciación o por representar varios grados de fusión parcial.
- FC sirve para:
 - Reducir al fundido en Fe, Mg, Ti, Ca y Na
 - Enriquecer al fundido en K y Si (feldespato alcalino y cuartzo).



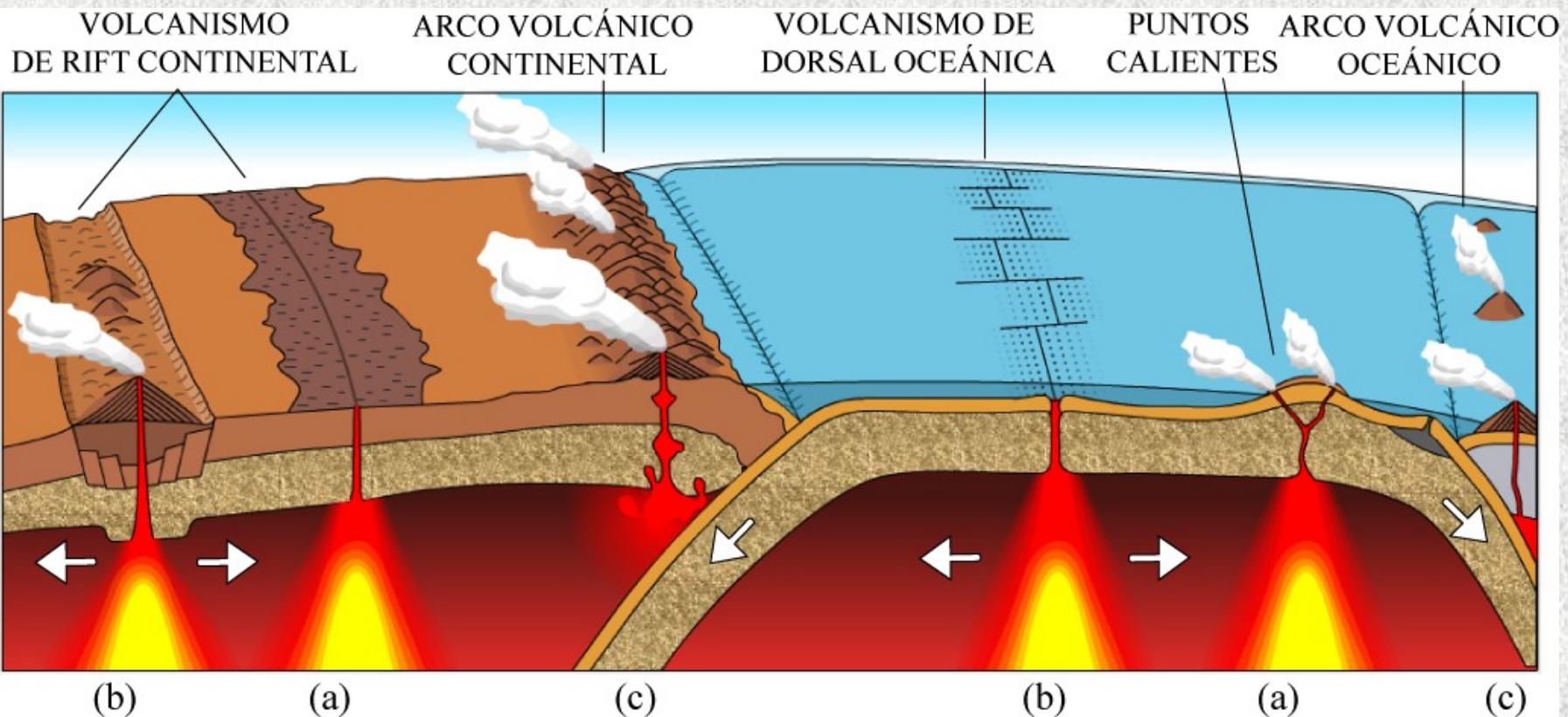
Chappell, B.W. and White, A.J.R., 2001. Two contrasting granite types: 25 years later. Australian Journal of Earth Sciences v.48, p.489-499.

Clasificación

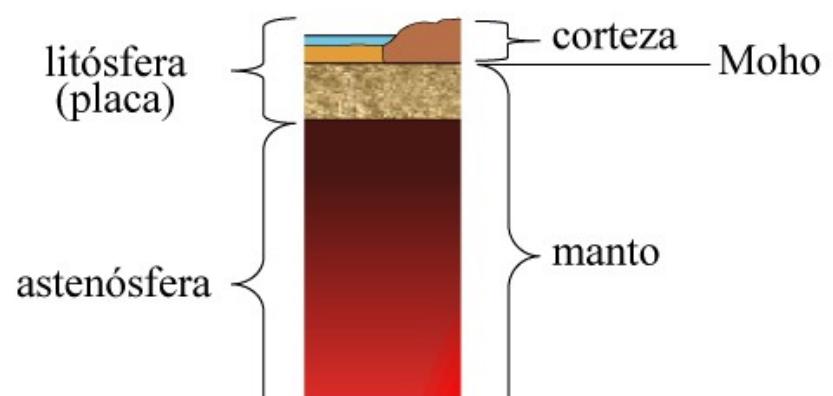
- Alfabética: esquema de Chappell & White :
 - *Tipo I* de protolito ígneo: + Plg
 - *Tipo S* de protolito sedimentario: + K-feld
- Son fundidos de rocas ultramáficas (+ FC) o sedimentarias, respectivamente.
- Otros:
 - *Tipo M* derivado del manto (+ FC).
 - *Tipo A* o *anorogenicos* formados sobre la actividad de "hot spot", con especial mineralogía y química. Son formados por la fusión de la corteza superior en condiciones extremadamente secas. Ej. equivalente: las riolitas de la caldera de Yellowstone.

Boroughs, S., Wolff, J., Bonnichsen, B., Godchaux, M., and Larson, P., 2005, Large-volume, low- $\delta^{18}\text{O}$ rhyolites of the central Snake River Plain, Idaho, USA: Geology 33: 821–824.

C.D. Frost, M. McCurry, R. Christiansen, K. Putirka and M. Kuntz, Extrusive A-type magmatism of the Yellowstone hot spot track 15th Goldschmidt Conference Field Trip AC-4. Field Trip Guide, University of Wyoming (2005) 76 pp., plus an appended map.



- (a) Fusión por un incremento de temperatura
- (b) Fusión por descompresión
- (c) Fusión por cambio de composición



Composición química

Harvey Blatt and Robert J. Tracy (1996). *Petrology*, 2nd edition, New York: Freeman, 66. Basados en 2.485 análisis:

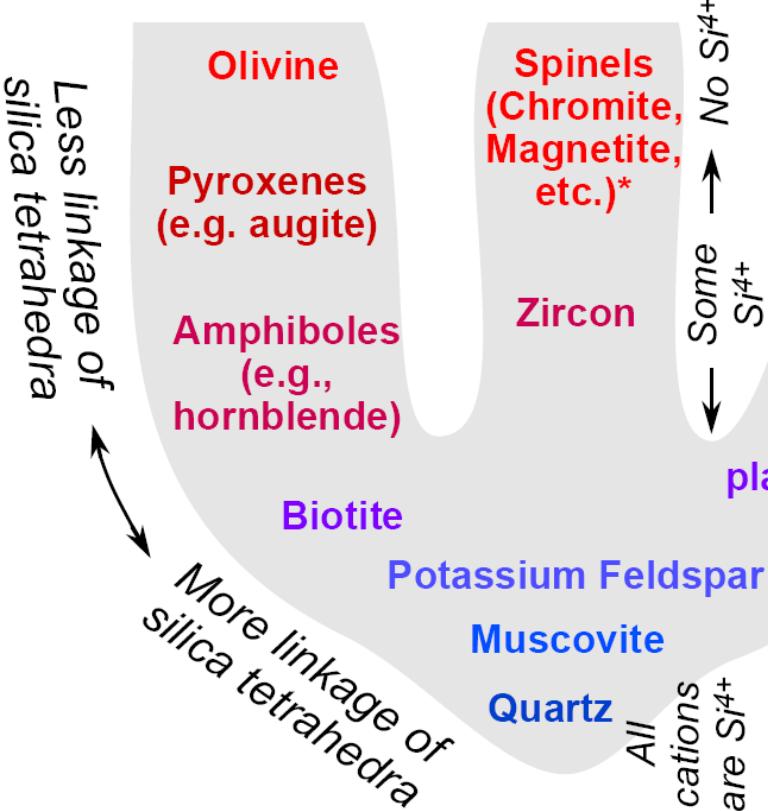
- SiO₂ — 72.04%
- Al₂O₃ — 14.42%
- K₂O — 4.12%
- Na₂O — 3.69%
- CaO — 1.82%
- FeO — 1.68%
- Fe₂O₃ — 1.22%
- MgO — 0.71%
- TiO₂ — 0.30%
- P₂O₅ — 0.12%
- MnO — 0.05%

Mineralogía

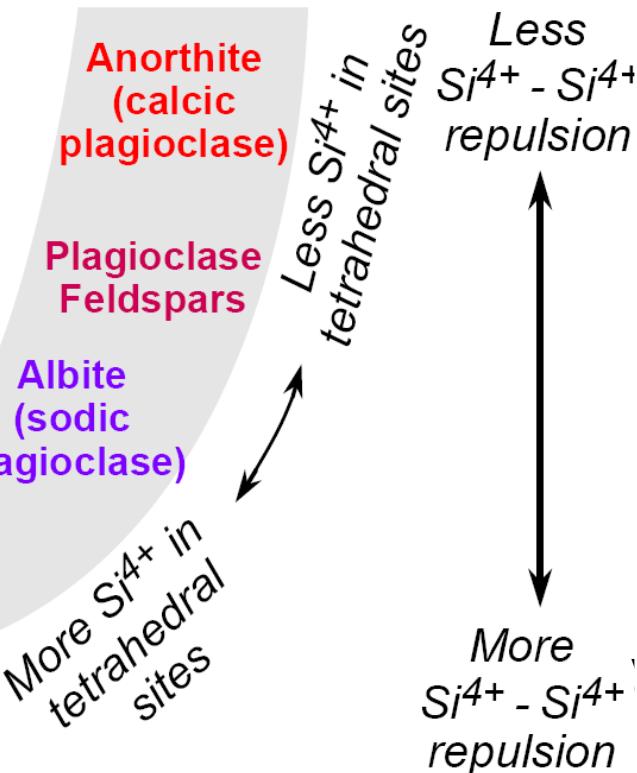
- Clasificado con el QAFP y A-Q-P
- Por convención tiene plagioclasa y feldespato alcalino
- De 2 micas: biotita y muscovita
 - alto K
 - tipo S o A

Series de reacción de Bowen

Serie discontinua



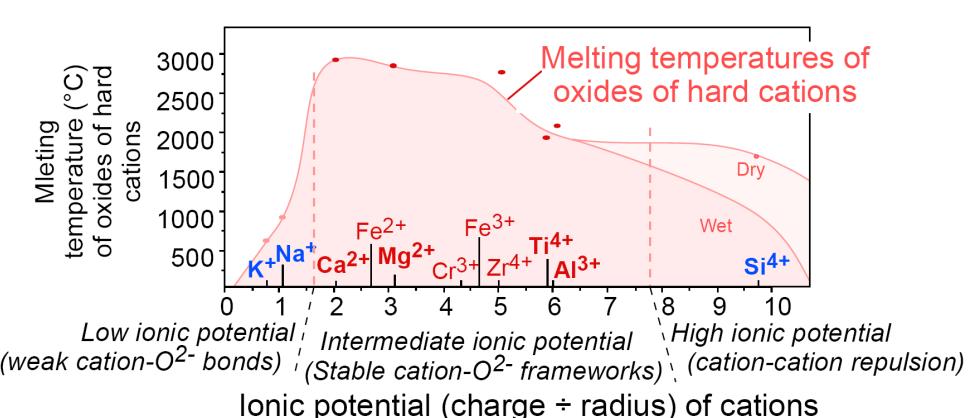
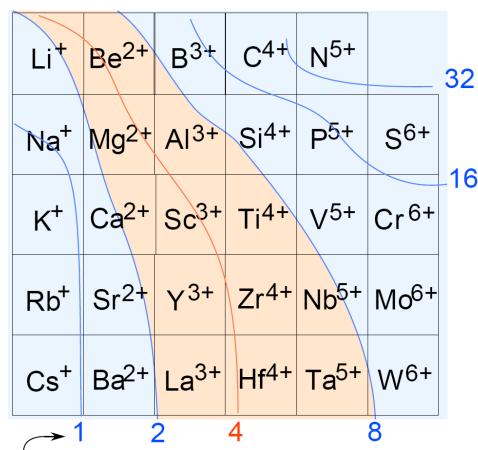
Serie continua



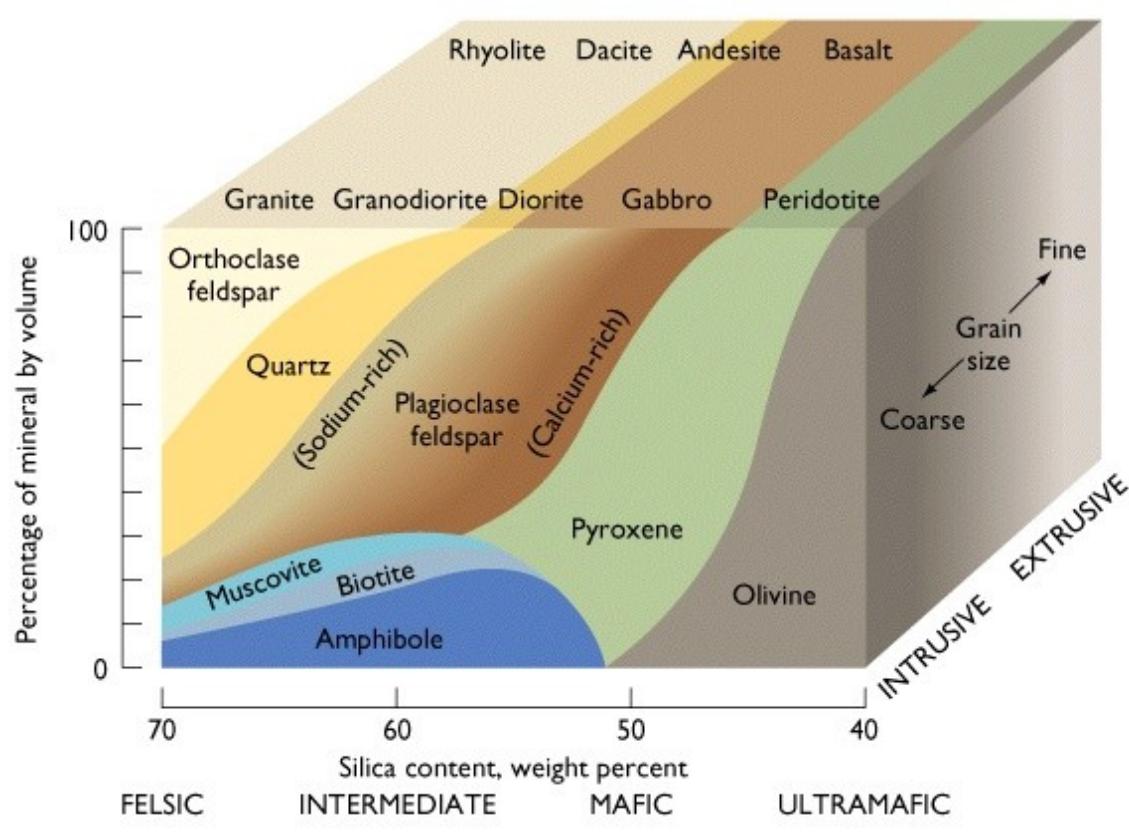
Cristalización a temperaturas más altas

Cristalización a temperaturas más bajas

Contornos de potencial iónico (carga/radio)



Clasificación de rocas plutónicas con base en la composición modal



Se aplica a rocas de grano grueso en las que sea posible determinar la composición modal.

Procedimiento

Determinar el contenido en la roca de los siguientes minerales:

Q = Cuarzo

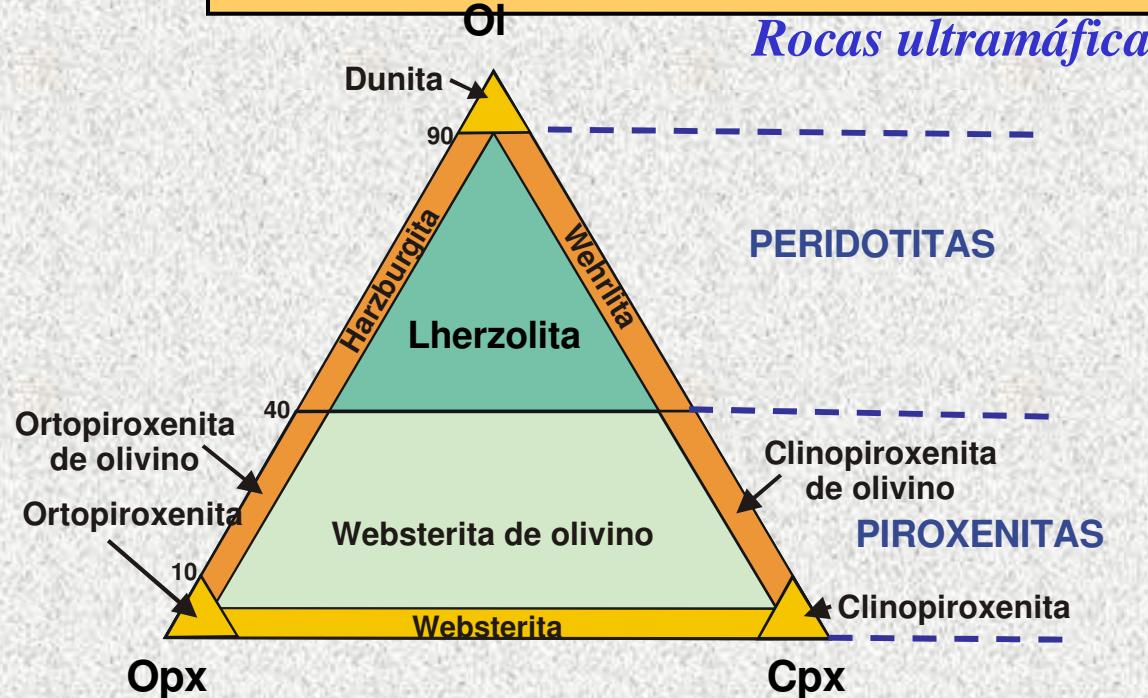
A = Feldespato alcalino

P = Plagioclasa

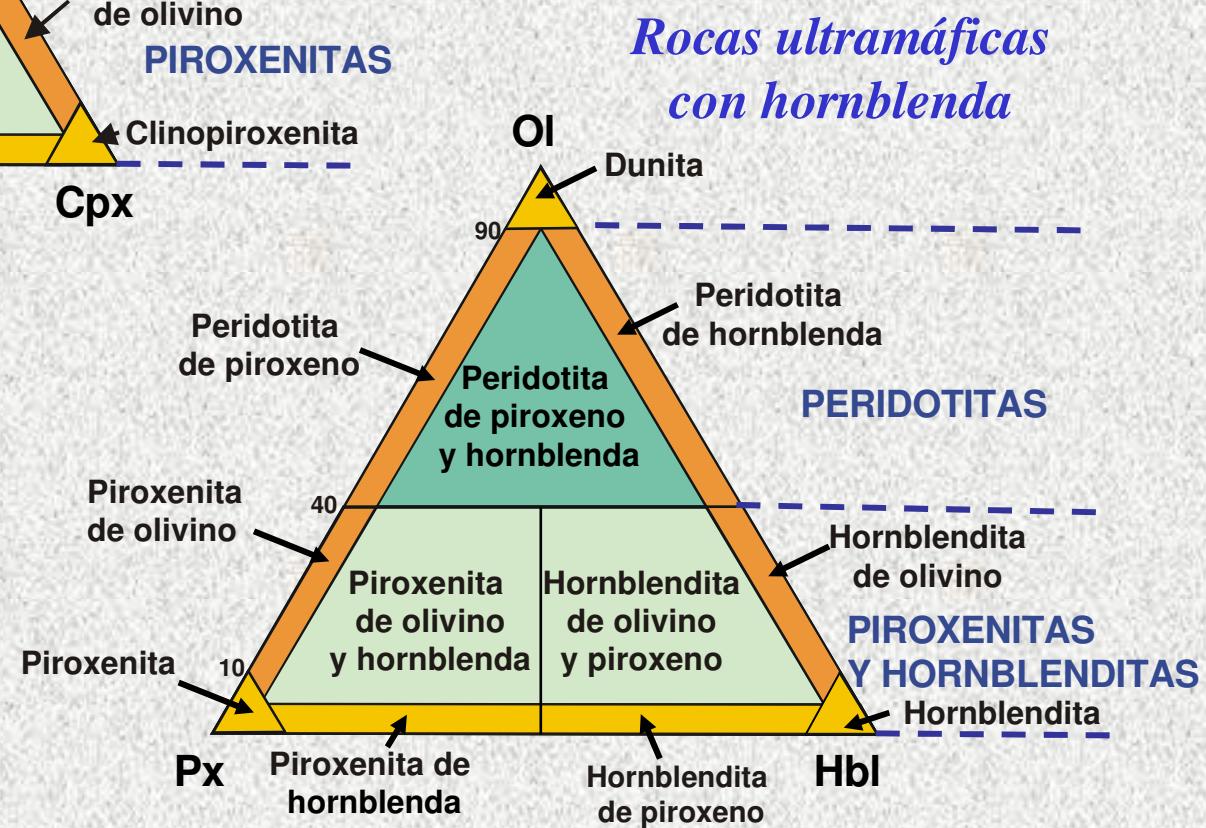
F = Feldspatoides

M = Máficos

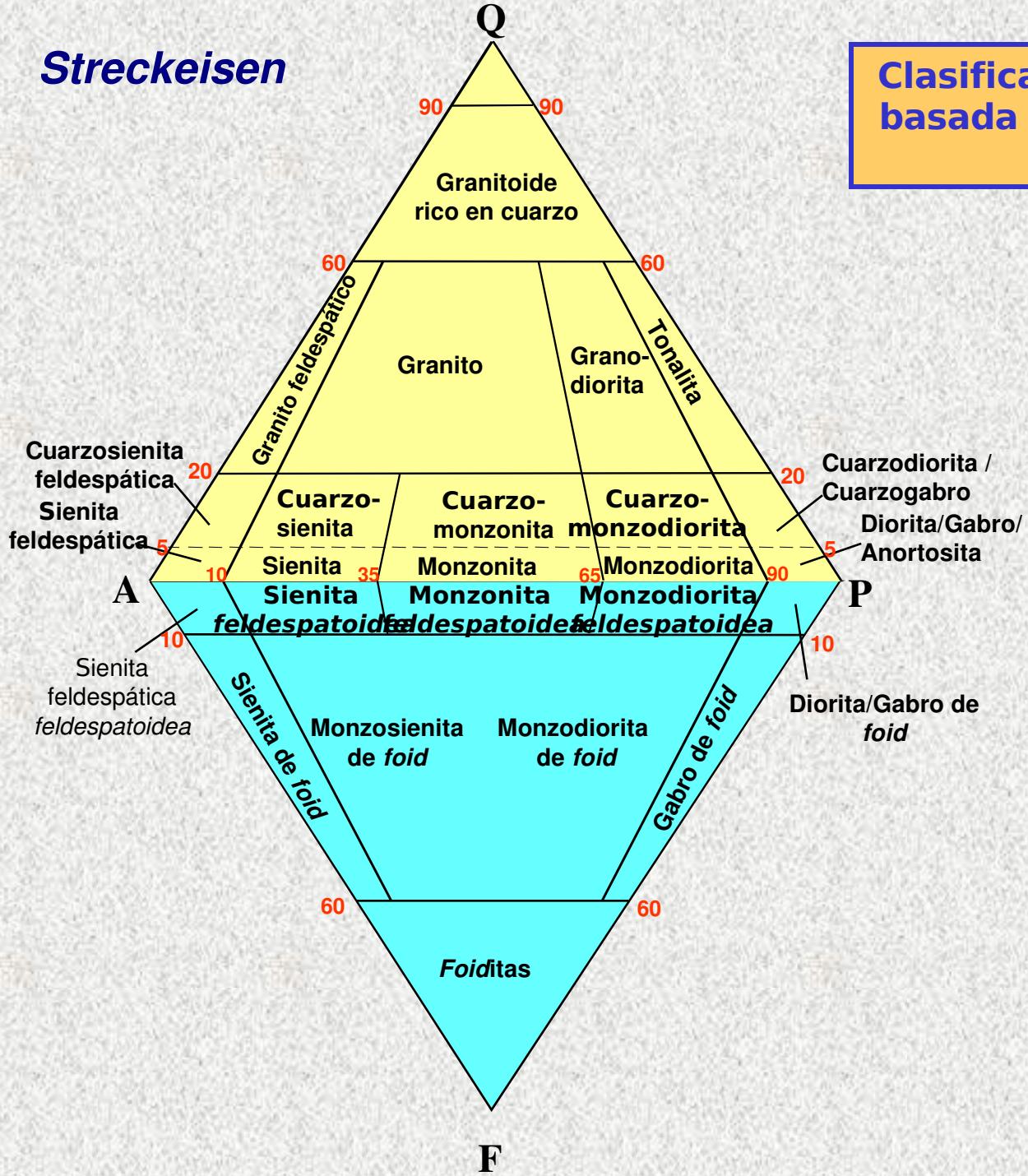
Clasificación de rocas plutónicas basada en la composición modal



Si M > 90 %



Streckeisen



Clasificación de rocas plutónicas
basada en la composición modal
IUGS

Si M < 90 %

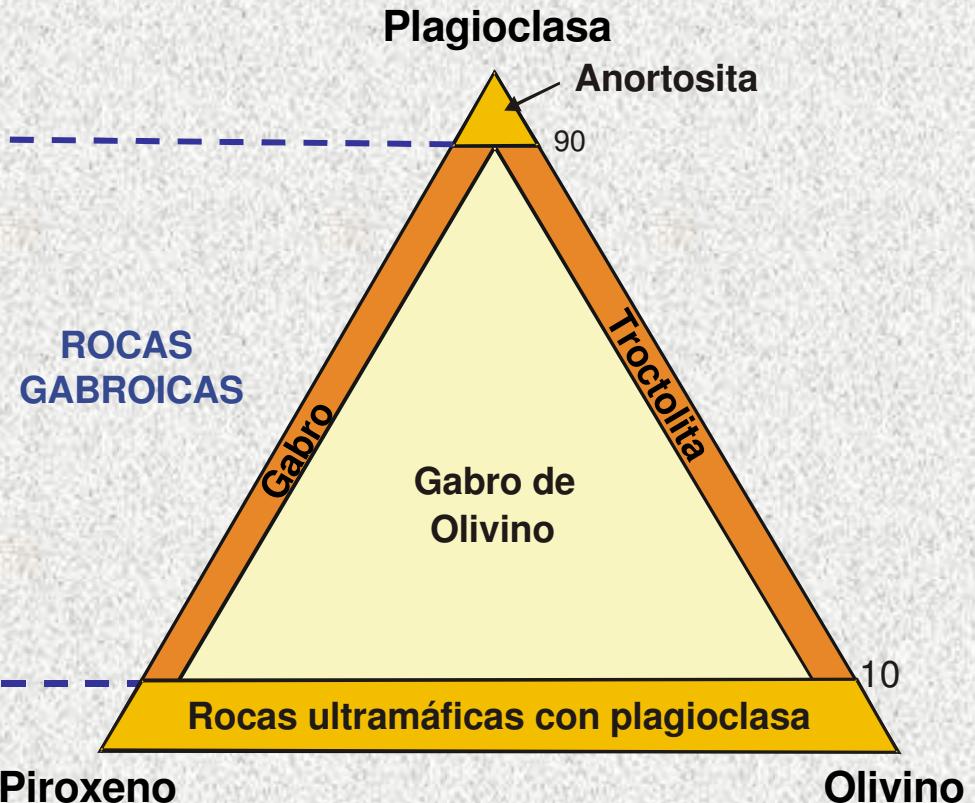
Recalcular los tres minerales
restantes al 100% :
Q, A, P (Ternario superior)
A, P, F (Ternario inferior)

La distinción entre gabro
y diorita se basa en el
contenido de An en plg:
An > 50 : gabro
An < 50 : diorita

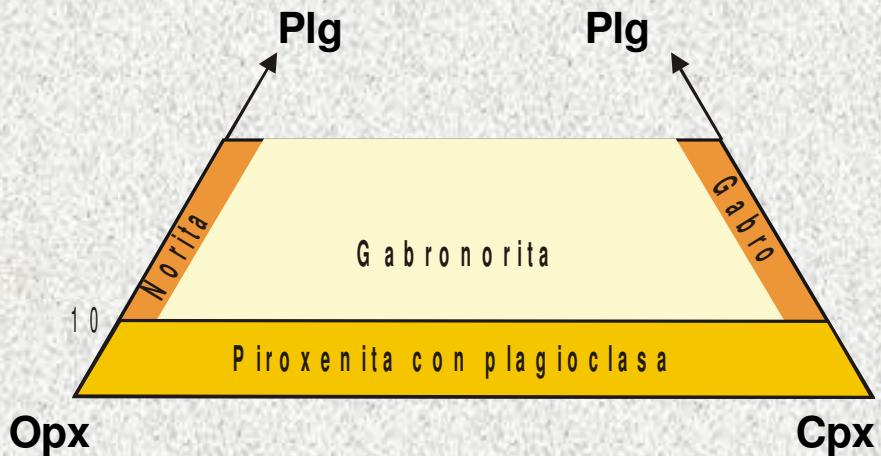
Los términos
“foid” y “feldespatoidea”
deben ser reemplazados por
el nombre del feldespatoide
presente,
p. ej. Sienita de nefelina,
Sienita nefelínica,
Nefelinita

Clasificación de rocas plutónicas basada en la composición modal

Rocas gabróicas

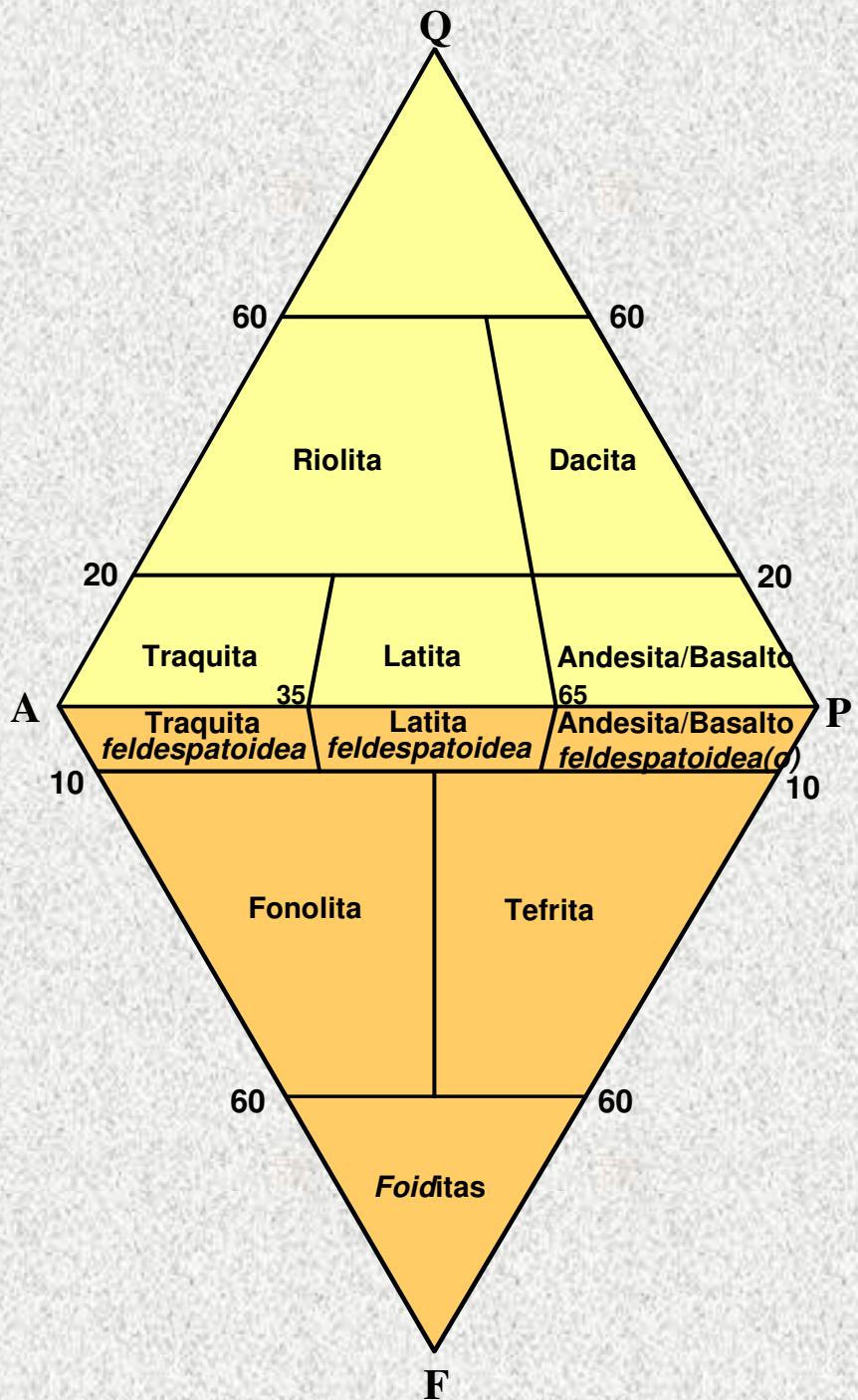


Rocas gabróicas con Opx



Clasificación y nomenclatura de rocas volcánicas basada en la composición modal (IUGS)

Los términos
“*fooid*” y “*feldespatoidea*”
deben ser reemplazados por
el nombre del feldespatoide
presente,
p. ej. Latita nefelínica,
Nefelinita



Ascenso

Hoy: Debate sobre la generación del ascenso
y emplazamiento de grandes volúmenes de
granito

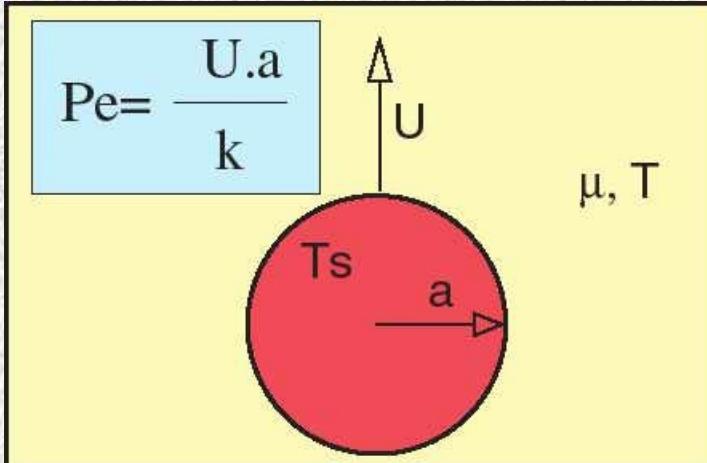
Las 2 mayores hipótesis son:

- Diapiros
- Propagación de Fractura

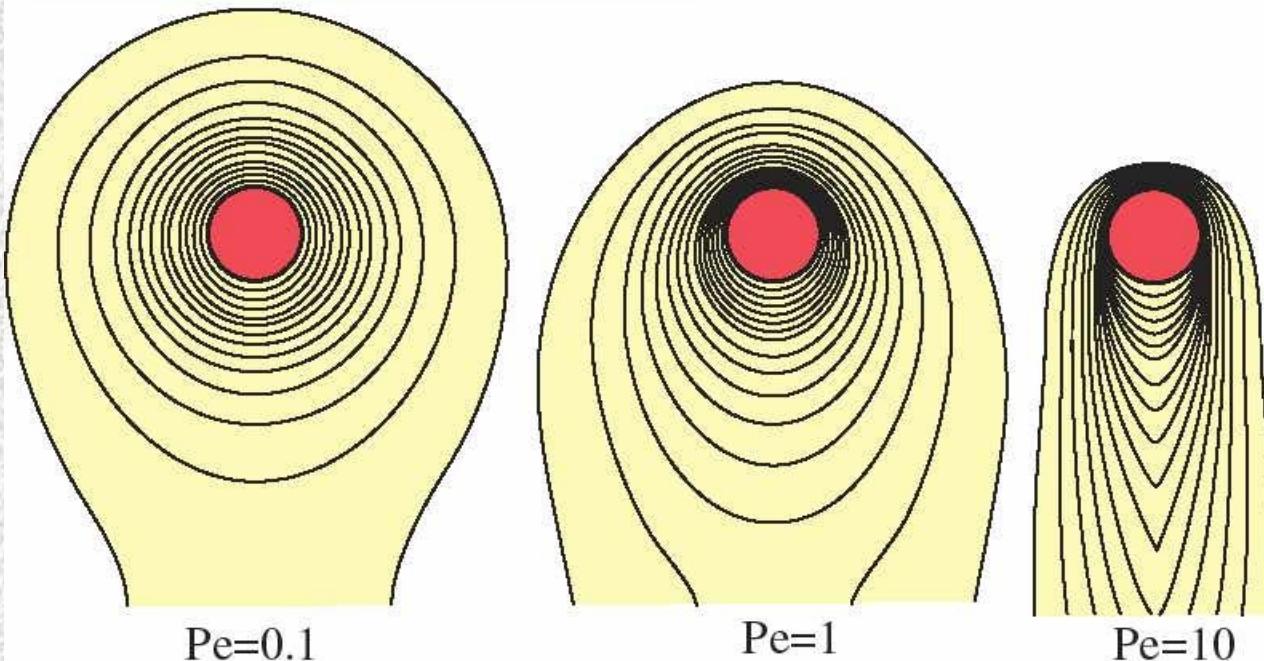
Diapiros

- FLOTABILIDAD: Ley de Stokes
- Las rocas deben fluir por el calentamiento, posibilitando el paso del pluton sin gran pérdida de calor (Weinberg, 1994).
- Es posible en la cálida y ductil corteza inferior.
- No es posible si las rocas no se deforman porque pierden mucha temperatura y solidifican

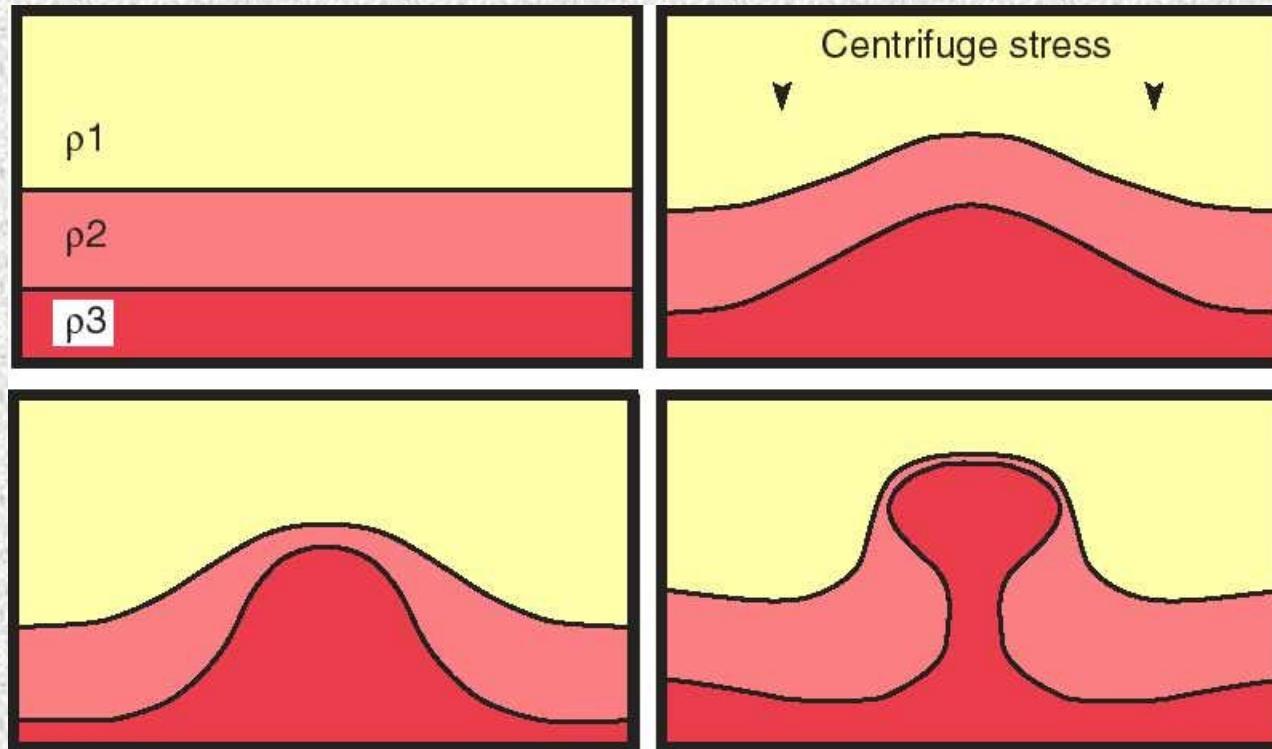
Clemens, John (1998). "Observations on the origins and ascent mechanisms of granitic magmas". *Journal of the Geological Society of London* **155** (Part 5): 843–51.



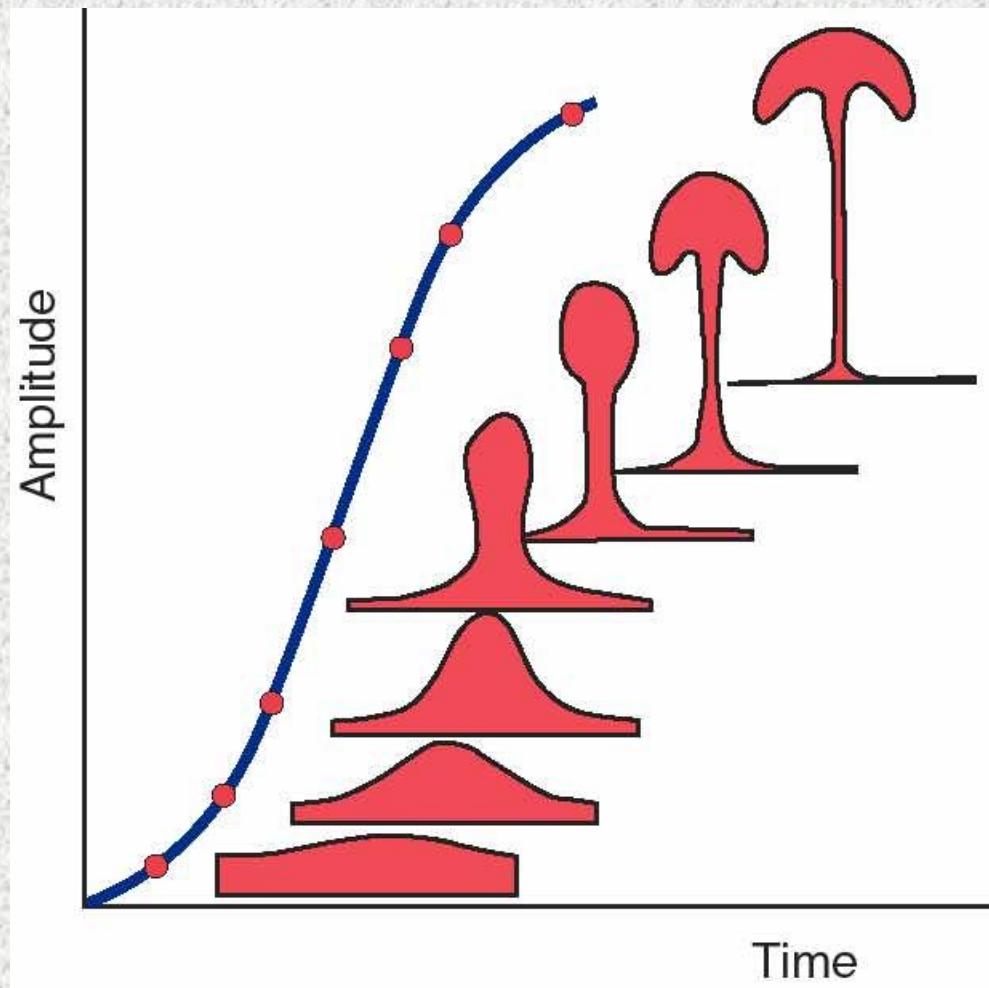
Model of a hot sphere at temperature T_s with a radius "a" and vertical velocity U , rising in a fluid of viscosity μ . The temperature far from the sphere is equal to T . Pe is the Peclet number and k the thermal diffusivity (Daly and Raefsky, 1985).



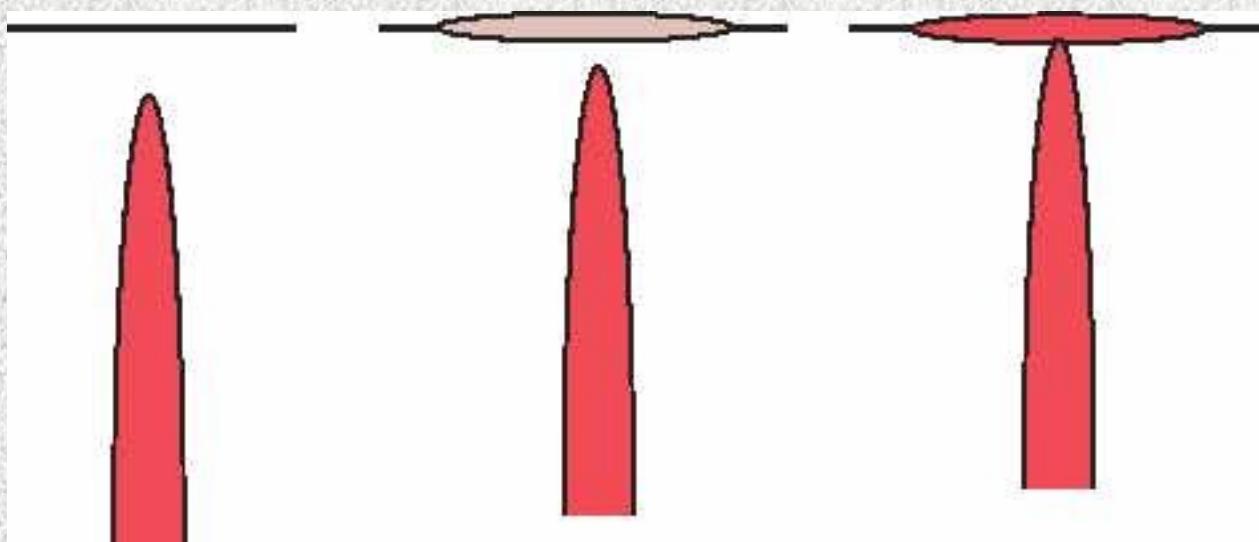
Experimento análogo de Dixon (1975)



Modelamiento numérico mostrando el crecimiento de un diapiro



Mecanismo de Cook y Gordon, 1964



Propagación de Fractura

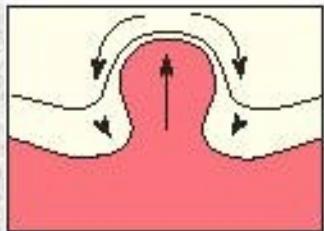
- Magma asciende a través de diques, generalmente en zonas de fracturas preexistentes y redes con activas zonas de cizalle (Clemens, 1998)
- En estos conductos abiertos el magma entra y solidifica, aislando termalmente los próximos pulsos.
- Los granitos deben hacerse espacio por si mismos a través del techo, o intruir otras rocas para formar una intrusión.

Clemens, John (1998). "Observations on the origins and ascent mechanisms of granitic magmas". *Journal of the Geological Society of London* **155** (Part 5): 843–51.

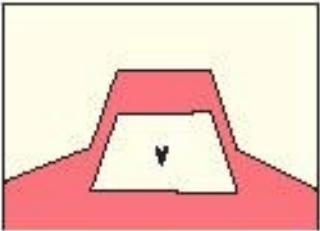
Para los grandes batolitos se han propuesto:

- Stoping, donde el granito fractura las rocas de la pared y empuja hacia fuera removiendo bloques de corteza sobreyacente.
- Asimilación, donde el granito funde y remueve su vía.
- Inflación, donde el cuerpo de granito se infla, causando un incremento en la presión, siendo inyectado.
- Combinación de todos.

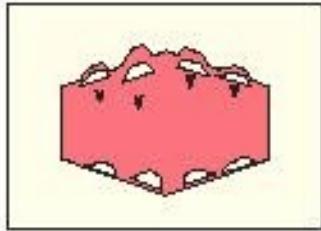
COUNTRY ROCKS MOVE DOWN (cross-sections)



Diapirism

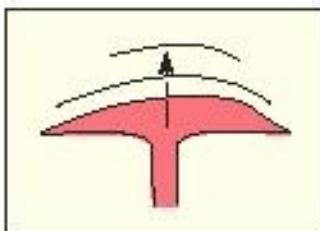


Cauldron subsidence



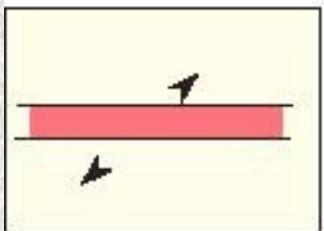
Stoping

COUNTRY ROCKS MOVE UP (cross-section)

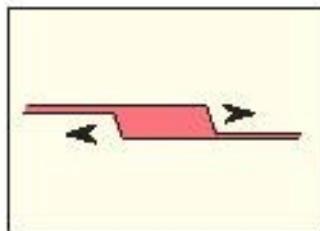


Doming

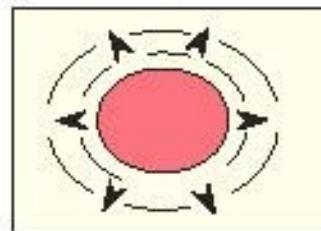
COUNTRY ROCKS MOVE LATERALLY (plan views)



Transtensional

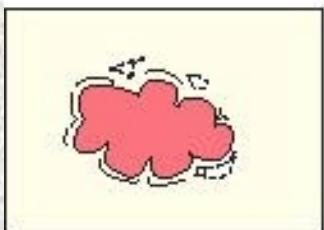


Transcurrent to transpressive

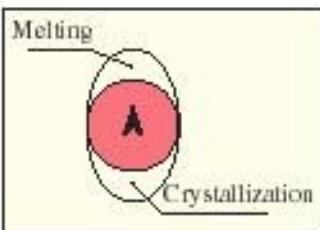


Ballooning

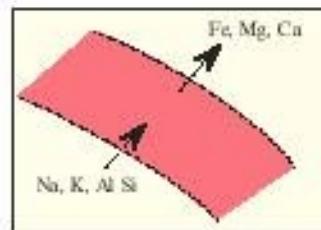
COUNTRY ROCKS DO NOT MOVE (cross-sections)



In-situ melting

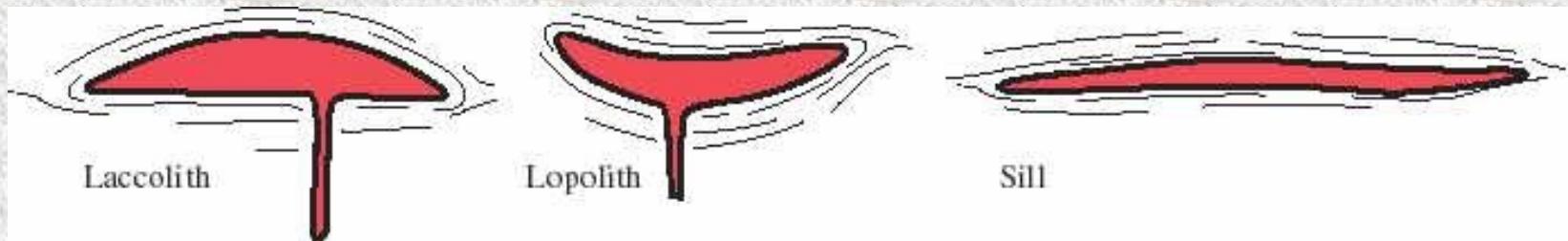


Zone melting

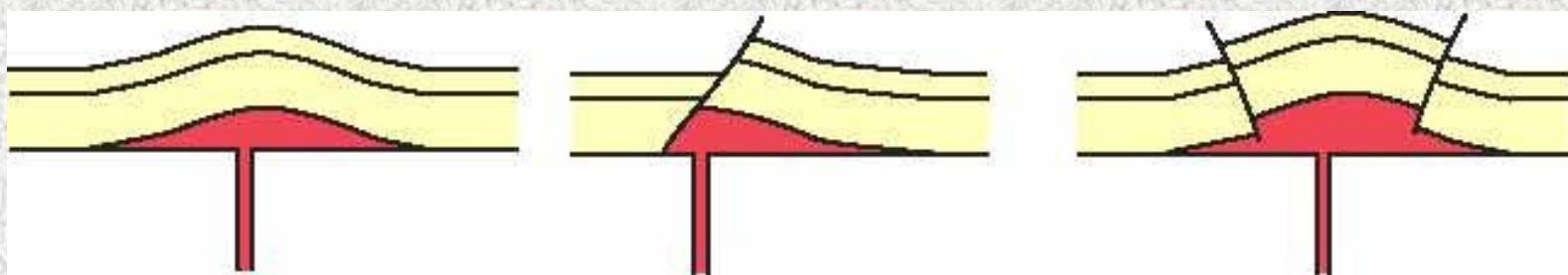


Granitization

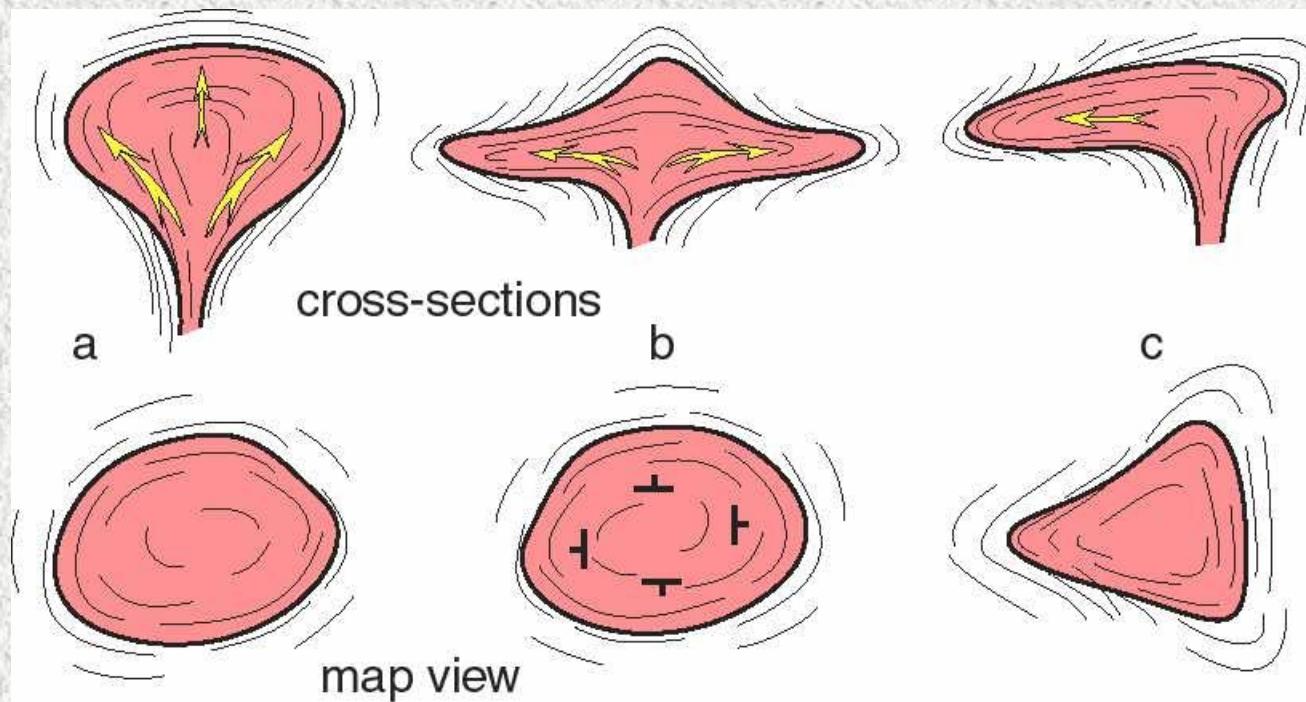
Formas planas



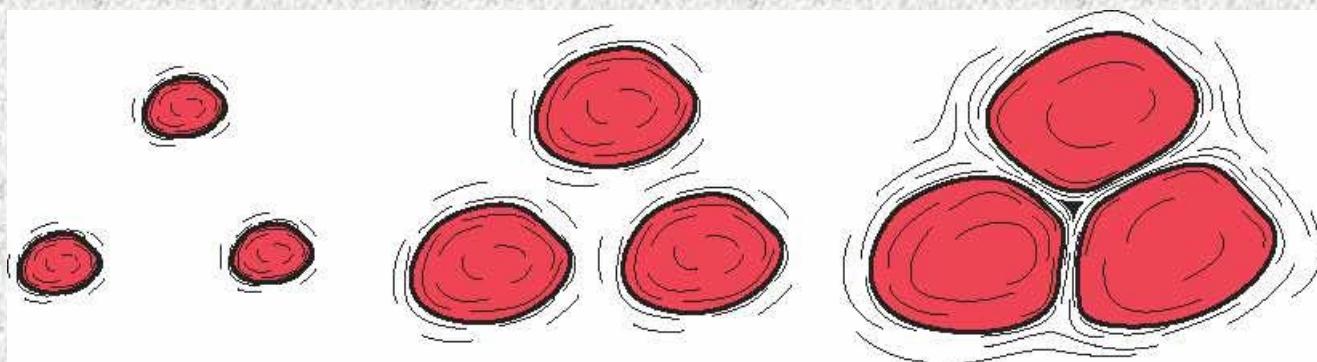
Influencia de las Fracturas



Secciones y Planta



Inteferencias de Strain Finito



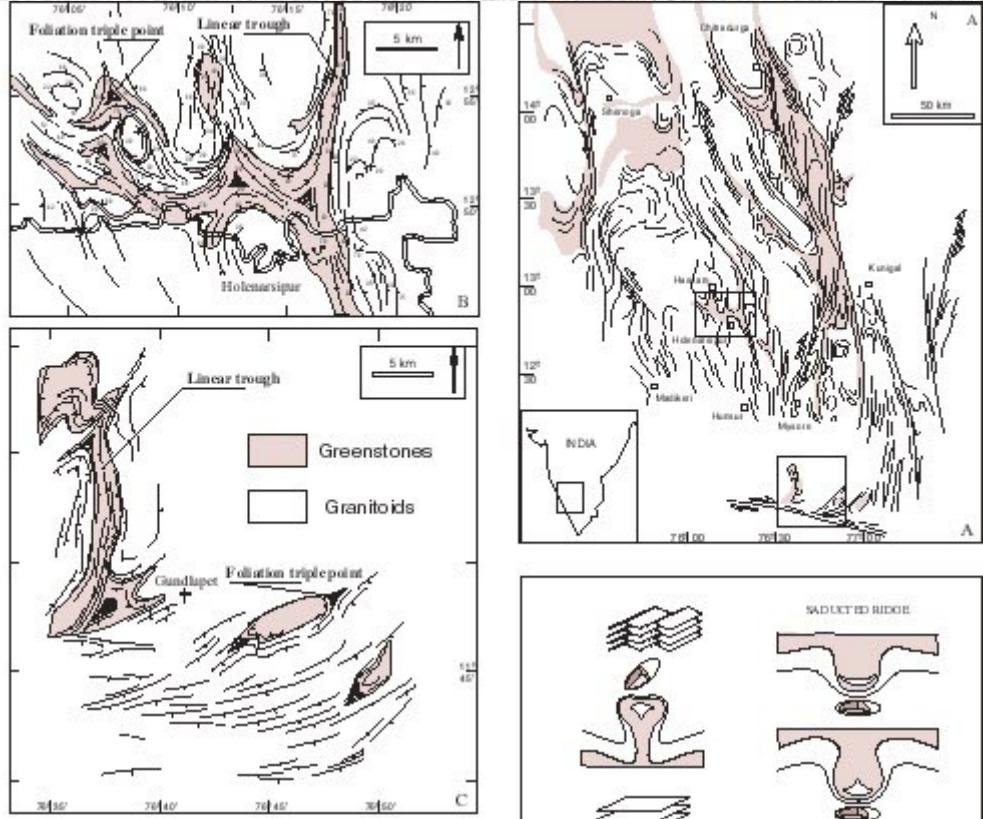
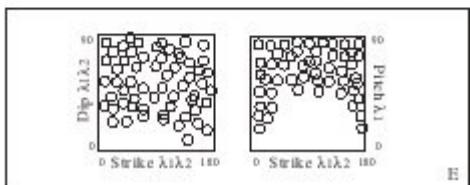
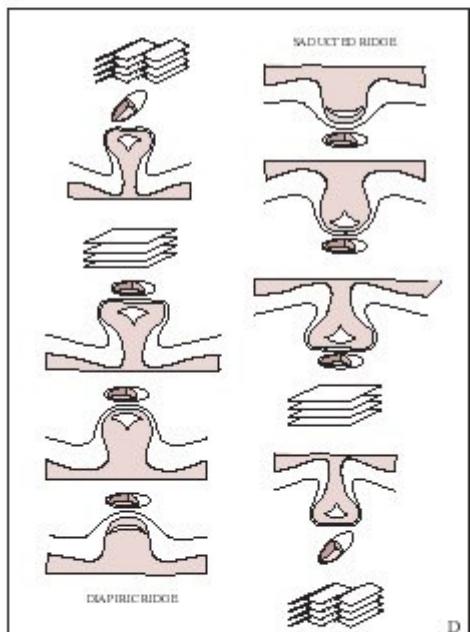


Figure 29: A; Structural sketch of the western part of the Dharwar craton (South India) showing the location of Holenarsipur (B) and Gundlupet (C) areas. A and C: Map of foliation trajectories in the Holenarsipur (B) and Gundlupet (C) areas, (Bouhaillier, 1995). These two areas represent two different structural levels within the Dharwar craton. The age (ca. 2525 Ma) of the amphibolite facies (5-7 kbar) of the Holenarsipur area is identical to the age of the granulite facies (7-9 kbar) of the Gundlupet area. Note the presence of antiform closures in the upper level (Holenarsipur area) and the presence of synformal closure in the lower section (Gundlupet area). D Strain field interferences between diapirism and regional tectonics, Bouhaillier et al., 1995. E Variation diagrams of the dip of $\lambda 1\lambda 2$ plane and pitch of $\lambda 1$.



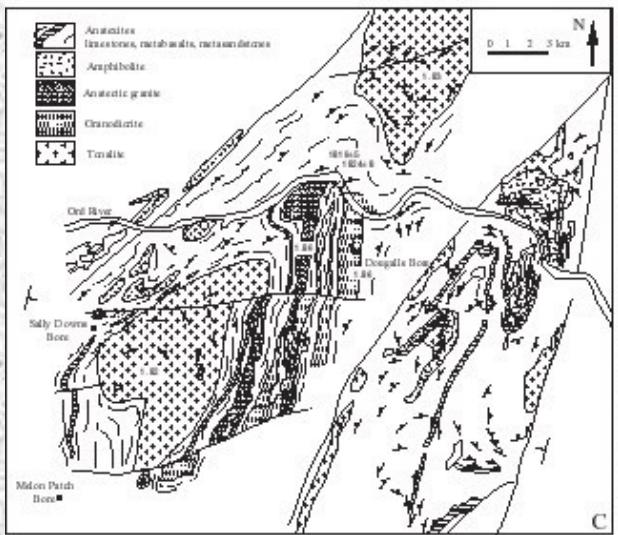
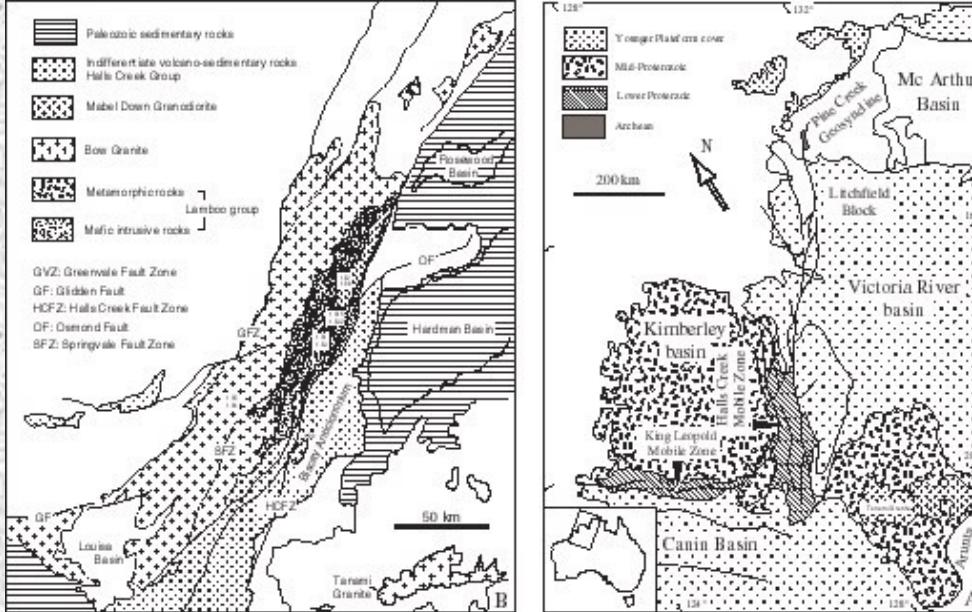
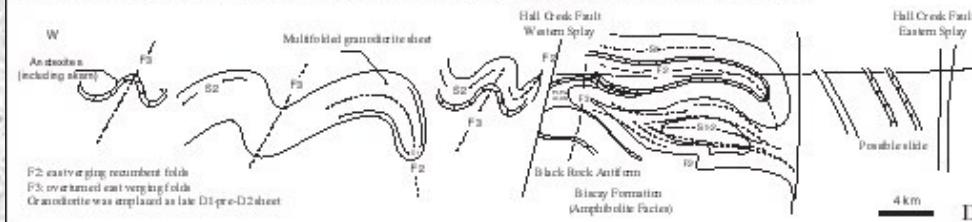


Figure 31: A - The Halls Creek Mobile Zone is part of the Barramundi Orogeny that affected the northern part of Australia during the Lower Proterozoic. B- Elongated batholiths and major strike slip faults are the two major features of the HCMZ. Felsic and mafic magmas intruded a metamorphic zone that occupy the central zone. C- Schematic geological map along the Ord River. A cross section is shown in D. Structural pattern in C- suggests the occurrence of large scale folding (F3) . This folding affects a former fabric (S2) axial planar of recumbent folds (F2). In the region of the Black Rock anticline the S2 fabric appears to be parallel to an even older S1 schistosity. The cross-section shown in D suggests that the refolding of recumbent folds dominates the regional structure. This work however did not address the significant of the fabric in the intrusive (it is magmatic), it do not address also the relationships between the intrusive and the faults zones..

Interpretative cross-section across the Halls Creek Mobile Zone (Hancock & Rutland, 1984; based on Gemuts, 1971)



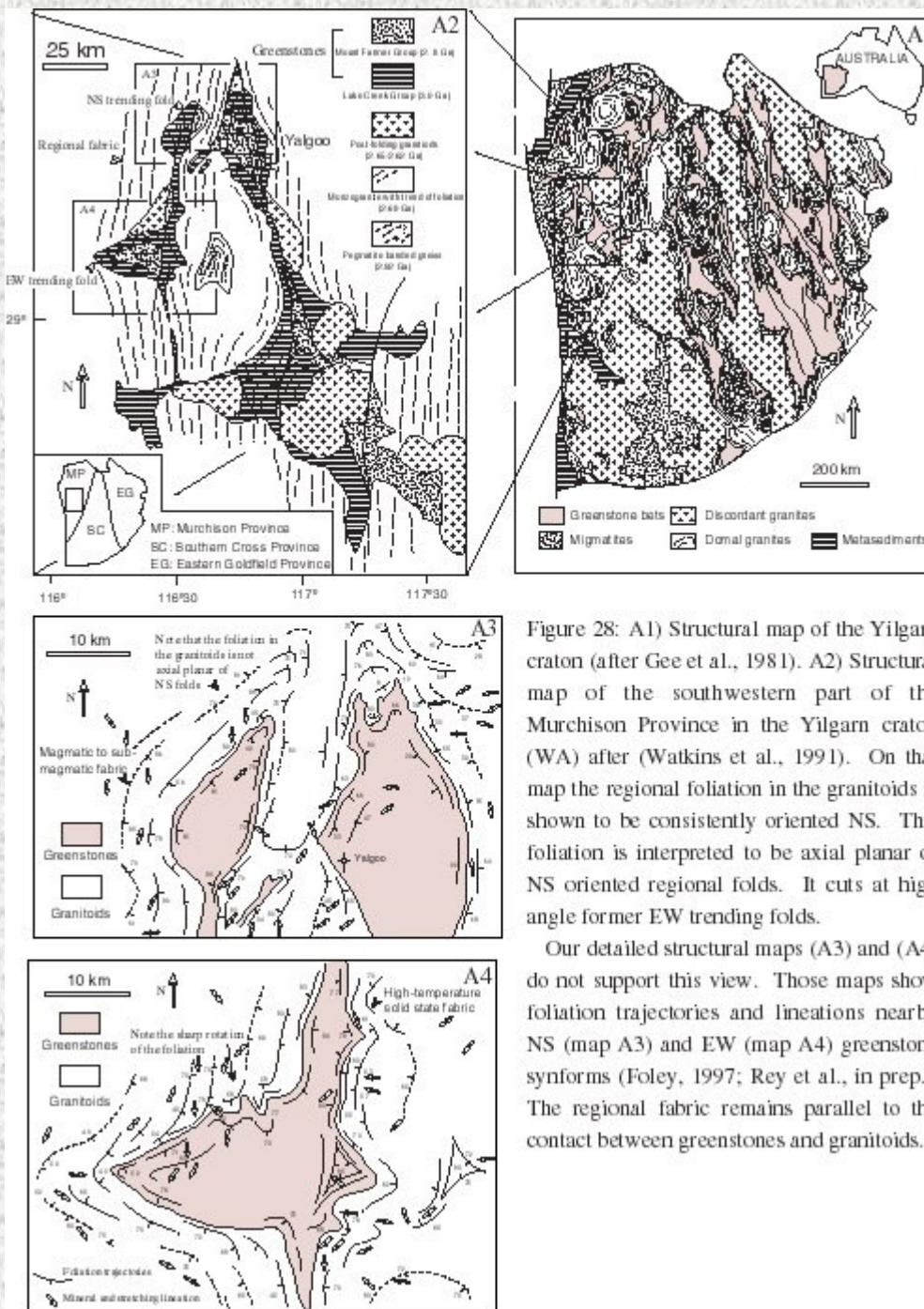
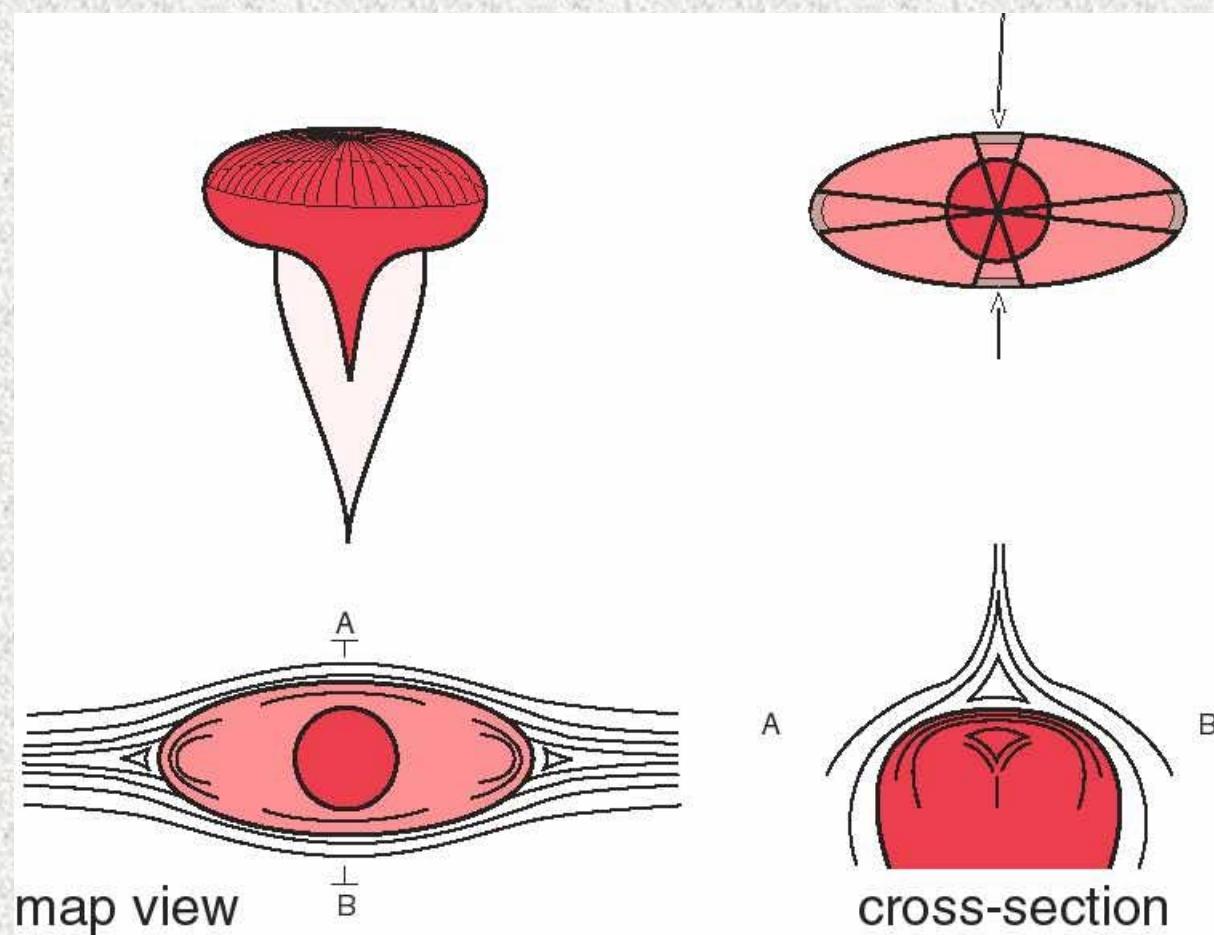


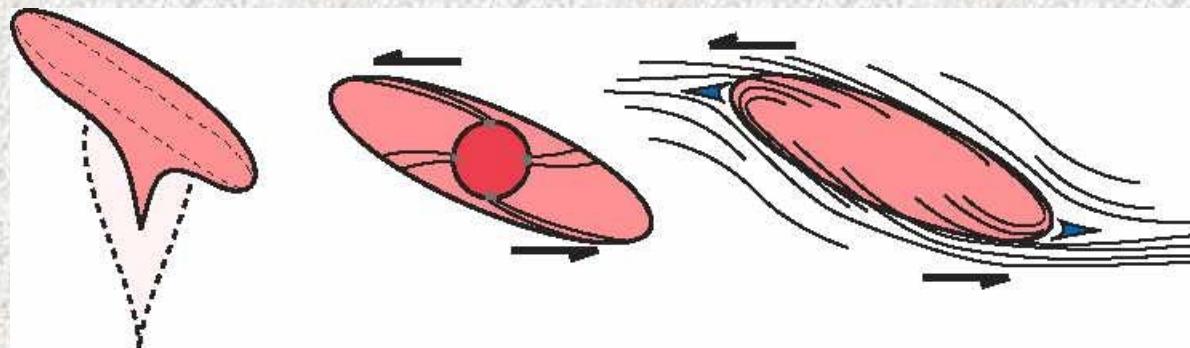
Figure 28: A1) Structural map of the Yilgarn craton (after Gee et al., 1981). A2) Structural map of the southwestern part of the Murchison Province in the Yilgarn craton (WA) after (Watkins et al., 1991). On that map the regional foliation in the granitoids is shown to be consistently oriented NS. This foliation is interpreted to be axial planar of NS oriented regional folds. It cuts at high angle former EW trending folds.

Our detailed structural maps (A3) and (A4) do not support this view. Those maps show foliation trajectories and lineations nearby NS (map A3) and EW (map A4) greenstone synforms (Foley, 1997; Rey et al., in prep.). The regional fabric remains parallel to the contact between greenstones and granitoids.

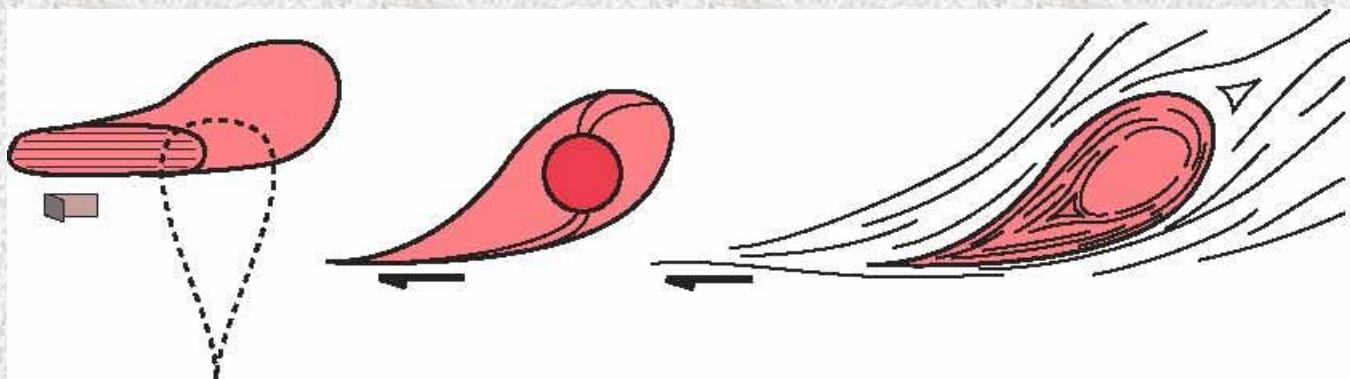
Expansión durante deformación regional co-axial



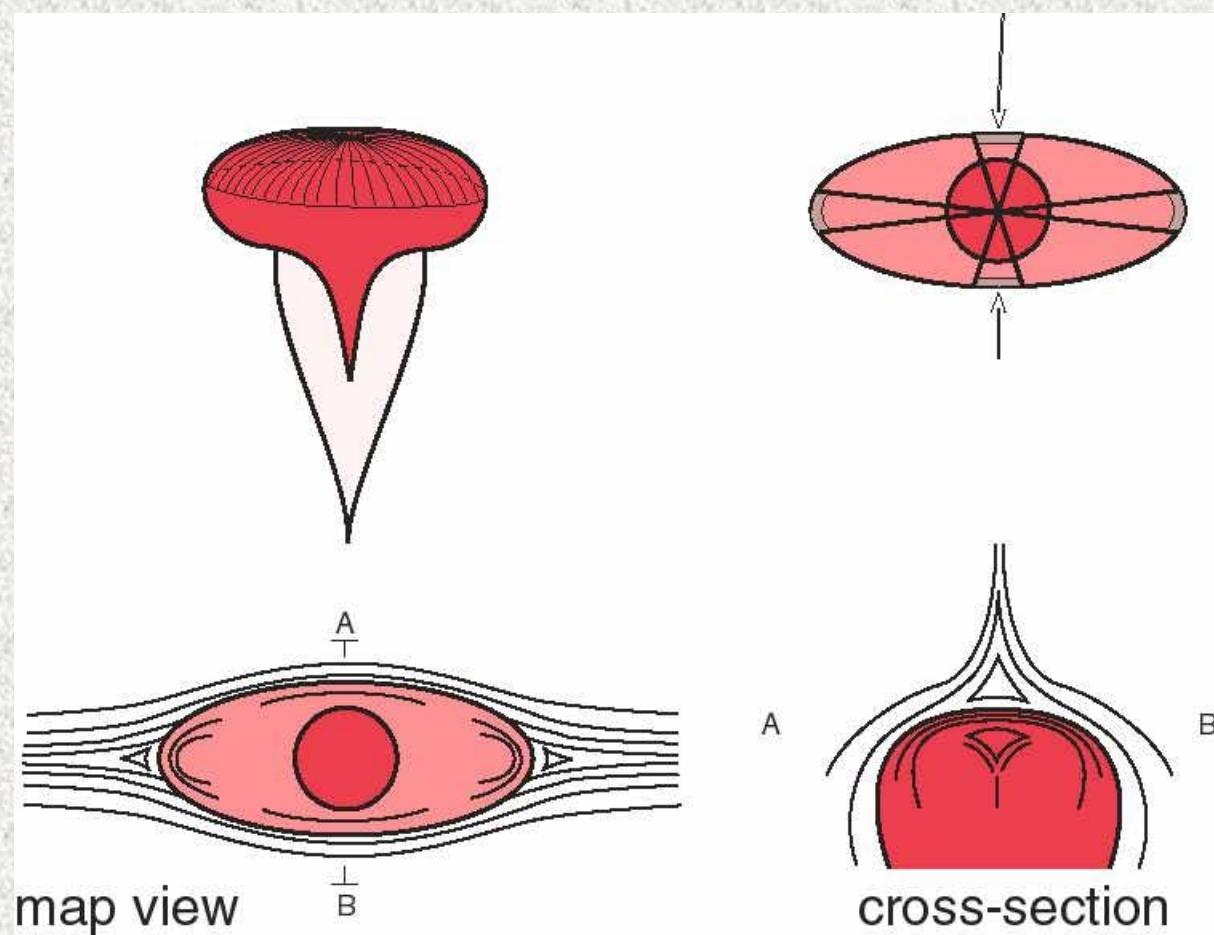
Expansión durante deformación regional homogénea no coaxial



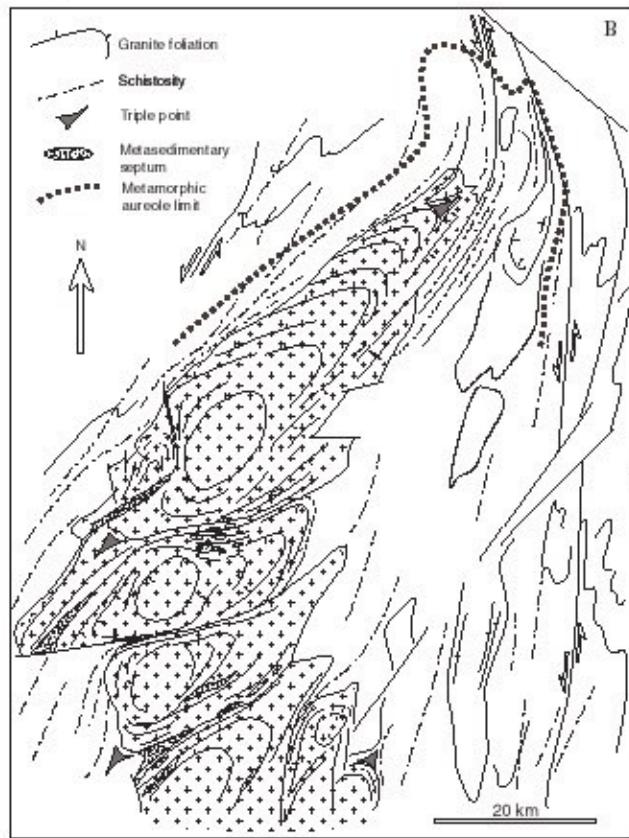
Expansión durante deformación regional heterogénea no coaxial



Expansión durante deformación regional co-axial



This is a simplified view of the geological map showing the surroundings of the Saraya batholith in the Eastern Senegal (Pons et al., 1992). This map represents the Saraya batholith as a large granitic rock masse, oriented SW-NE, intrusive within a sequence of schist.



The foliation trajectories map shows that the Saraya batholith is in fact a composite body formed by the coalescence of half a dozen single pluton. This structural map gives access not only to the three dimensional structure of the terrain but also provides a visual understanding of its dynamics. The strain pattern shows that the plutons have expanded toward the NE transforming diapir into granitic sheets (see below).

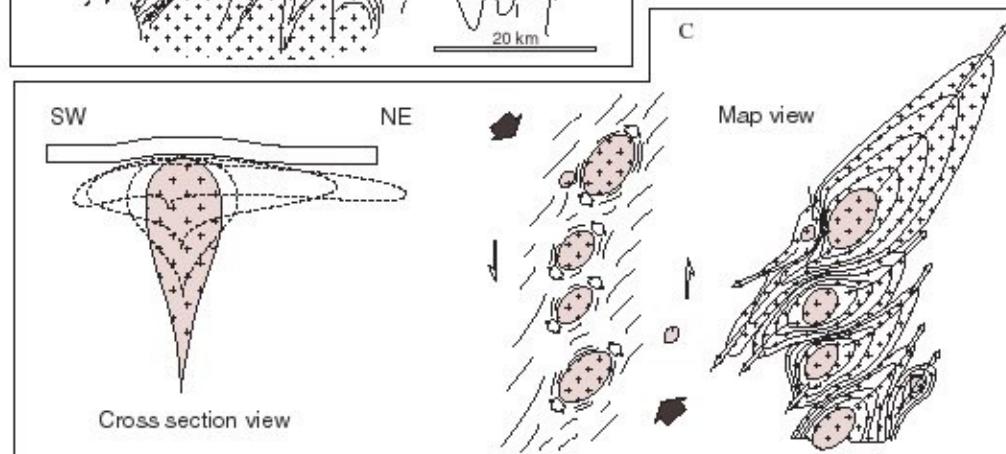


Figure 30: The Saraya batholith and its associated strain field (Pons et al., 1992)

Escalada tradicional



Ej: San Gabriel

