The Controls on Vanadium, Iron and Zinc Stable Isotope Fractionation in Upper Crustal Plutons

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Electronic Appendix 5 - Red Hill Petrographic Descriptions

Sample	Lithology	Primocryst Phases	Interstitial Phases	Textural Observations
65	Chilled Margin	Groundmass: Plagioclase, Pyroxenes, Fe-Ti Oxides Phenocrysts: Orthopyroxene, Plagioclase		Fine grained crystalline groundmass (97%) containing plagioclase, pyroxene and Fe-Ti oxides. Minor phenocrysts (<3%) of orthopyroxene and plagioclase, <1mm in size.
32	Dolerite	Plagioclase: 50% Augite: 25% Pigeonite: 25%	Quartz: <1% Fe-Ti-Oxides: 1% Sulphides: <0.1%	• Silicates: Tabular, randomly orientated plagioclase grains. Pyroxenes envelop plagioclase crystals in a poikilitic texture. • Fe-Ti Oxides: Titanomagnetite and ilmenite, with anhedral, void filling morphologies. No obvious exsolution lamellae. Under RL, grains appear altered.
21	Dolerite	No Thin Section for this sample		
47	Dolerite	Plagioclase: 55% Pigeonite: 25% Augite: 20%	Fe-Ti Oxides: 1-2% Sulphides: <0.1%	• Silicates: Tabular, randomly orientated plagioclase grains. Pyroxene grains occur as 0.5-2mm individual grains, often clustered together. • Fe-Ti Oxides: Titanomagnetite and ilmenite. Anhedral, void filling morphologies, found interstitial to plagioclase. Titanomagnetite grains appear altered (grey/white cloudy appearance).
35	Dolerite	Plagioclase: 55% Pigeonite: 20% Augite: 20%	Orthoclase: 2% Quartz: 1% Fe-Ti Oxides: 1-2% Sulphides: <0.1% Biotite: <0.1%	• Silicates: Euhedral plagioclase grains with no overall orientation. Individual, prismatic pyroxene crystals (up to 5mm), often have altered rims and cracks (green/brown coloured material). • Fe-Ti Oxides: Titanomagnetite and ilmenite, with anhedral, void filling morphologies, found interstitial to plagioclase. Sometimes occurring as clusters. No obvious exsolution lamellae.

74	Pegmatite Dolerite	Plagioclase: 50% Pigeonite: 20% Augite: 20%	Quartz/Orthoclase: <5% Fe-Ti Oxides: 5% Sulphides: <0.1%	• Silicates: Coarser grain size than the other dolerites. Elongated, tabular pyroxene and plagioclase grains up to 1 cm long. Pyroxene altered along rims and cracks (green/brown coloured material). Interstitial patches of granophyric intergrowths of quartz and orthoclase. Some interstitial sites filled with fibrous, radiating, green/brown mineral. • Fe-Ti Oxides: Found near pyroxene crystals. Generally euhedral shaped grains. Magnetite with extensive exsolution of ilmenite. Exsolved ilmenite exists as trellis lamellae and as granular exsolution. Often closely spatially associated with sulphides.
63	Pegmatite Dolerite	Plagioclase: 40% Pigeonite: 15% Augite: 25%	Quartz/Orthoclase: 10% Fe-Ti Oxides:5% Sulphides: <0.1% Iddingsite?: 5%	• Silicates: Euhedral, brown-green coloured pyroxenes, altered, often with amphibole rims. Interstitial quartz and orthoclase between plagioclase crystals. Interstitial amorphous brown/orange material – olivine altered to iddingsite? • Fe-Ti Oxides: Anhedral, void filling grains of magnetite and ilmenite. Grains often appear altered and can have a ragged appearance.
52	Quartz Dolerite	Plagioclase: 40% Pigeonite: 15% Augite: 23%	Quartz/ Orthoclase: 20% Fe-Ti Oxides: 2% Sulphides: <0.1%	• Silicates: Euhedral, tabular plagioclase crystals with no preferred orientation. Increasing abundance of interstitial quartz and orthoclase. Pyroxene crystals can be large (>5mm), tabular, and often envelope plagioclase crystals. • Fe-Ti Oxides: Anhedral, void filling grains. Magnetite with ilmenite exsolution.
61	Quartz Dolerite	Plagioclase: 45% Augite: 20% Pigeonite: 15%	Quartz/Orthoclase:15% Fe-Ti Oxides: 4% Sulphides: <0.1%	• Silicates: Euhedral plagioclase, interstitial quartz and orthoclase. Tabular pyroxene crystals have grown

				against and partially enveloped plagioclase crystals. Pyroxene crystals often have brown, altered rims. • Fe-Ti Oxides: Anhedral, void filling grains. Magnetite with ilmenite exsolution. Can have ragged appearances.
50	Quartz Dolerite	Plagioclase: 40% Augite: 20% Pigeonite: 15%	Quartz/Orthoclase: 20% Fe-Ti Oxides: 2% Sulphides: <0.1%	• Silicates: Elongate, tabular >5mm pyroxene grains, with green/brown coloured altered rims. Euhedral plagioclase with no preferred orientation, interstitial quartz and orthoclase. • Fe-Ti Oxides: Individual grains up to 5mm in size, but still seem to be void filling. Mostly magnetite with some ilmenite exsolution.
44	Fayalite Granophyre	Augite: 20-25% Pigeonite: <5% Quartz: 10% Orthoclase: 10% Plagioclase: 30% Olivine (altered to iddingsite): <5%	Fe-Ti Oxides: >10% Amphibole: <2%, as rims around pyroxene Sulphides: <0.1%	• Silicates: Brown pyroxenes with green amphibole along rims, and often orange staining along fractures. Increase in the abundance of quartz and orthoclase, now occurring as 0.5mm size euhedral grains as well as fine grained intergrowths. • Fe-Ti oxides: Large >1mm Fe-Ti oxide grains. Potentially iddingsite that has been fully replaced by magnetite, with extensive ilmenite exsolution lamellae? Often closely associated with pyroxene boundaries.
54	Fayalite Granophyre	Olivine (altered to iddingsite): 10% Augite: 15% Quartz: 20% Orthoclase: 25% Plagioclase: 30%	Amphibole: <2% , as rims around pyroxene Fe-Ti Oxides: 5% Sulphides: <0.1%	• Silicates: Tabular pyroxene and plagioclase crystals. Pyroxene is pink/brown coloured (ferroaugite), often rimmed by brown/green amphibole. Fayalite has been altered to iddingsite. Granophyric intergrowths, and individual prismatic crystals, of quartz and orthoclase. • Fe-Ti oxides: Discrete, euhedral titanomagnetite grains with extensive ilmenite exsolution lamellae. Often closely spatially associated with iddingsite (reaction texture of iddingsite being replaced by magnetite?).

38	Granophyre	Quartz/Orthoclase: >60% Plagioclase: 20% Pyroxene: 15%	Fe-Ti Oxides: 5% Sulphides: <0.1%	• Silicates: Majority of the sample composed of granophyric intergrowths, and individual crystals, of quartz and orthoclase. Pyroxene as pale brown/green coloured elongated crystals (4x0.5mm). • Fe-Ti oxides: Discrete titanomagnetite grains with extensive ilmenite exsolution lamellae
14	Granophyre	Quartz/Orthoclase: 80% Plagioclase: 10% Pyroxene: <5%	Fe-Ti Oxides: 5% Sulphides: <0.1%	• Silicates: Very fine grained (0.1mm) equant grains of quartz and orthoclase. Individual, light green coloured pyroxene crystals. Elongate, thin plagioclase crystals, often highly altered (seriticized?). • Fe-Ti oxides: Fine grained (0.1mm) titanomagnetite grains with extensive ilmenite exsolution lamellae, disseminated throughout the quartz and orthoclase.
15	Granophyre	No Thin Section for this sample		