**Point counting**

The method used in this study is compared to those used by previous workers. These methods are sufficiently similar to allow useful comparisons of the data to be made.

*Point count data templates*

The point counting was carried out by using a microscope with an electronic stage attached, which has the capability of selecting random grains across the full area of the thin section, thus providing an unbiased representation of any sample. 300 grains were counted from each of the chosen thin sections. The grains were counted into number different categories: monocrystalline quartz (Qm), polycrystalline quartz (Qp), microcrystalline quartz (Qmi), undifferentiated K-feldspar and plagioclase (F) and lithic fragments (L). the latter category includes basic and intrusive volcanics, feldspar-phyric basalt, sedimentary and metamorphic rock, pyroxene, hornblende, detrital opaque grains (oxides/sulphides), mica, chlorite and fossils.

*‘Dickinson’ template*

The classic ‘Dickinson’ templates which we use here are based on data from Dickinson & Suczek (1979), as presented by Dickinson *et al.* (1983). The papers present two ternary plots based around quartz, feldspar and lithics. In the first plot the data are plotted as feldspar versus all types of quartz, versus lithics, whereas in the second plot, feldspar is plotted against monocrystalline quartz versus combined lithics, polycrystalline quartz and microcrystalline quartz. Dickinson & Suczek (1979) indicate that the main difference between the two plots is whether chert is included with the quartz field or the lithic field. When chert is combined with monocrystalline quartz, the ‘continental block’ and ‘recycled orogen’ provenance fields tend to merge (Dickinson & Suczek 1979). Therefore, we utilise the second diagram: F-Qm-L+Qp+Qmi (where poly- and micro-crystalline quartz are included as lithics), as this effectively discriminates between the various provenances and provides a good indication of any mature quartz preserved within the sandstone samples.

*Literature data comparison*

The new data are compared with unpublished results from BSc, MSc and PhD theses of the University of Otago, and also some published data (Aitchison & Landis 1990; Cawood 1986). Unpublished data are used for comparison with the Upukerora, Wooded Peak, Tramway, Little Ben and Greville Formations. Mainly published data are used for comparisons with the Stephens Subgroup and the Waiua Formation. To compare previous results with our new data, we draw a series of fields on our Qm-F-L plots, which show both the full distribution of previous data and the concentration of these data. The solid and dashed lines are used to show the full distribution of data from each formation. Solid versus dashed lines are used to show the distribution of data within any stratigraphic member of each formation. The grey shaded areas show the main concentrations of points. When points cover the entire field then the whole field is shaded; if the main body of data plots is in a small portion of the field, with numerous outliers, then only a small part of the field is shaded.

The data used for the Upukerora, Wooded Peak, Tramway and Little Ben Formations are from Owen (1995), which is a compilation of data made from several sources; i.e. Owen (1995), Hyden (1979); Pillai (1981, 1989) and Stratford (1990). These data are from the Wairoa-Lee River and Southland areas. The Greville Formation data are from Stratford (1990), based on samples from West Dome. Our Stephens Subgroup and Waiua Formation results are compared with data from the Stephens Subgroup from Aitchison & Landis (1990). This paper has point count data for the Acheron Lakes Formation, Cerberus Formation, Eldon Formation and Snowdon Formation (Stephens Subgroup). The samples used for the previous point counting come from the Countess Range, Snowdon Peak and Mararoa River areas.

*Owen (1995) point-counting method*

Owen (1995) used the Gazzi-Dickinson point-counting technique, using the Zuffa (1985) 62.5µm grain size threshold to limit grain size bias in the point count data. Zuffa’s (l985) paper suggests that if you have a polycrystalline grain (polymineralic), and within this grain there are crystals >62.5µm in size, then these are considered as an individual grain. Therefore, as Owen (1985) notes, any crystal >62.5µm, whether within a grain or the matrix, is point counted as a grain. This method has been suggested to help reduce grain size bias in point count data by Ingersoll *et al.* (1984) and by Zuffa (1985).

Owen (1995) carried out point counting of the following categories: quartz, feldspar, ferromagnesian minerals, Fe-Ti oxides, sedimentary lithics, plutonic lithics, volcanic lithics, microlitic volcanic lithics (i.e. groundmass of feldspar and metamorphic minerals), felsic volcanic lithics (i.e. groundmass of quartz, albite, feldspar and Fe-Ti oxides*),* devitirified volcanic lithics, microspheroids and matrix and cement. Matrix is classified as detrital grains if < 62.5µm (Zuffa 1985).

Owen (1995) plotted his data on QFL plots, where Q incorporates monocrystalline quartz and polycrystalline quartz (<62.5µm).

*Stratford (1990) point-counting method*

Stratford (1990) gives a brief description in the appendix of his MSc, stating that 400 points were counted per section into the following categories: polycrystalline quartz, monocrystalline quartz (although this is 0 for all samples), plagioclase, volcanic lithics, unknown lithics, sedimentary lithics, pyroxene, amphibole, opaques, chlorite pseudomorphs, chlorite, phyllite, serpentinite, mica, chlorite, prehnite, sphene, epidote and matrix.

*Aitchison & Landis (1990) point-counting method*

Aitchison & Landis (1990) do not provide specific details of their point-count method. From their data table, the following categories were point counted: monocrystalline quartz, polycrystalline quartz, feldspar, felsic lithic volcanics, microlitic lithic volcanics, sediment lithics (silt), sedimentary lithics (sand), pyroxene, miscellaneous and matrix. 120 samples where point counted, but only averages from each formation/subgroup. The data are then plotted, first on a diagram showing the average data and secondly, based on area.

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