# Preface

Almost all schist terranes of the world host some gold-bearing quartz veins, and most of these have been mined historically to some extent. From the early Middle Eastern civilisations, and particularly during the time of the Roman Empire, mining of these veins has yielded gold in variable quantities in the ancient world. The same style of mining activity, with remarkably similar approaches and technology, persisted and spread throughout the world to the early 20th century. A small proportion of the vein systems were sufficiently continuous and gold rich to permit long-term mining, and some famous mines now extend for kilometres below the surface. However, most of the old mines extend only a few metres or tens of metres into the basement rocks before petering out as the physical and technological issues of following the veins overcame the value of the gold that was being extracted. Hence, remnants of these abandoned small, shallow historic mine workings are a common feature of the landscape in these schist terranes.

The presence of these historic workings has been a powerful attractor for subsequent exploration activities, especially at times of rising gold prices in the latter parts of the 20th century and on into the present century. The principal exploration target has remained the quartz veins themselves, by analogy with the few long-established mines. However, modern technology now allows practical and economic gold extraction from weakly mineralised rocks adjacent to the quartz veins as well as the quartz veins themselves. This increases the size of the exploration targets, and the volume of potential mineable rock, albeit with much lower gold grades than was historically economic. The result of these technological changes is the evolution of a new gold mine type in schist terranes: large tonnage, low grade operations in which the gold-bearing quartz veins are a relatively minor part.

Refractory and preg-robbing ore have traditionally caused issues of low gold recovery in orogenic gold deposits. These issues arose at the modern Macraes deposit, but recovery improved with introduction of new pressure oxidation technology. Modern mines have to work under stricter environmental regulations than in the past, and sensitive surrounding inhabitants ensure that environmental

standards remain high. In particular, arsenic is a significant issue around orogenic gold mines, especially large mines like Macraes. However, judicious water and tailings management can limit the environmental footprint.

These new technological developments make all the small shallow historic mines of particular interest for modern exploration. Most will not yield new mines, but this can only be determined by active exploration and associated applied research. This book provides geological context and structural and geochemical frameworks for a successful project that turned what was a small set of schist-hosted quartz veins exposed in old mine workings into the world-class Macraes gold mine. Many of the key geological and geochemical features of the formation processes and resultant ore types at Macraes have direct effects on metallurgical characteristics and downstream environmental issues, and these practical and economic aspects are also incorporated into the narrative.

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