Arc volcanism and sedimentation in a synkinematic Paleoproterozoic basin: Rosebel Gold Mine, northeastern Suriname

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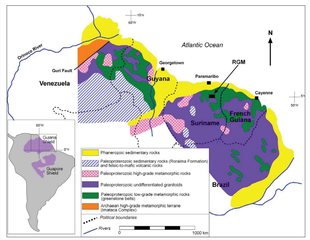
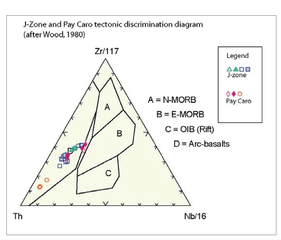
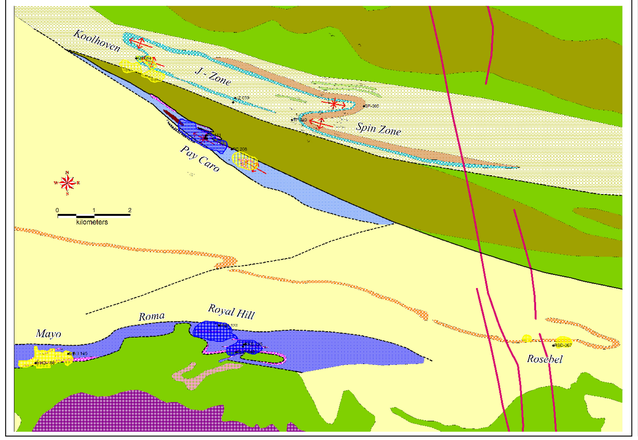
In Memory of Tom Watson

Tom Watson passed away much too soon in February 2013. This work constituted a major part of his M.S. thesis completed in 2008 and Tom's work gave us new insight into the geologic history of this important area.

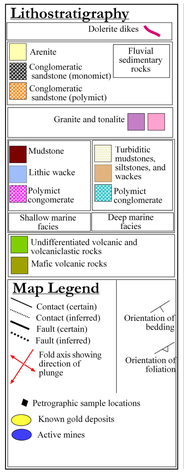




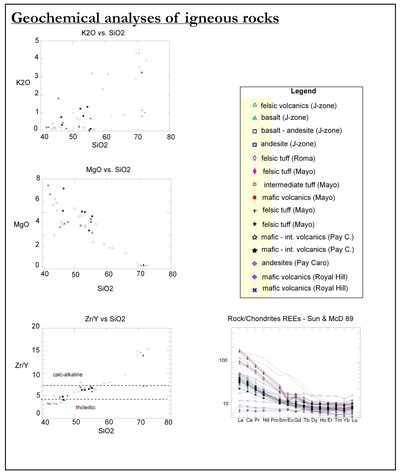
Geologic map of Rosebel Concession



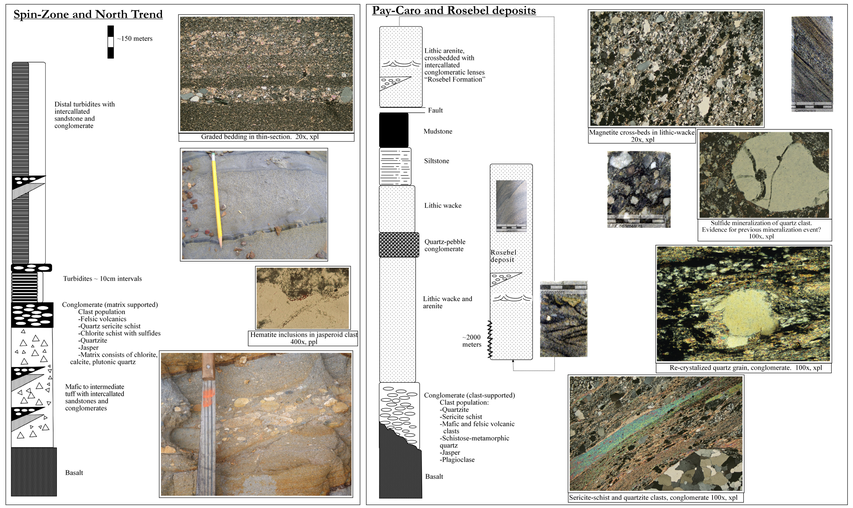
Lithostratigraphy



Geochemical analyses of igneous rocks



Generalized stratigraphic columns for RGM deposits (refer to map above for location names)



SUMMARY

The rocks at RGM represent different types of volcanism and sedimentation attributable to changing tectonic setting, and the development of different depositional environments during the Paleoproterozoic. Igneous rocks range from mafic to felsic, and show tholeiitic to calk-alkaline affinities. The tholeiitic rocks show REE patterns similar to those of other Paleoproterozoic volcanic arcs, and the intermediate to felsic rocks have REE distributions consistent with island arcs as well. Royal Hill mafic volcanic rocks represent the earliest phase of volcanism, and are relatively un-enriched in incompatible REE's, although they are still 10 to 20 times more enriched in REE's than chondrites, and are therefore probably arc- basalts. Pay Caro rocks represent intermediate phase of volcanism, and have a greater enrichment in incompatible REE's. Finally, Mayo rocks are the most enriched in incompatible REE's, and probably represent the last phase of volcanism. Brinck's granite is similarly enriched in incompatible REE's as are the Mayo igneous rocks, and is therefore also associated with a later phase of magmatism than the other igneous rocks at RGM.

The sedimentary rocks at RGM show four different lithofacies associations. (1) A deep-water, turbiditic series of wackes, conglomerates, and mudstones comprise the Koolhoven and J-Zone rocks. These rocks consist of distal to proximal facies and deposit mafic and felsic clastic material in a submarine slope environment. (2) Steep, syn-deformational sub-aerial to shallow-water alluvial processes disperse mafic and felsic sediment of the Royal Hill deposit. These deposits probably originated in an alluvial fan - braided stream environment. (3) Alluvial deposits in the Mayo area show bimodal volcanic association and are related to late-phase volcanism. (4) A clastic marine deposit in which volcanic and terrigenous material comprise proximal facies, and mainly terrigenous material comprises distal facies is evident in the rocks of Pay Caro. This sequence is unconformably overlain by a younger, mainly terrigenous conglomeratic sandstone, locally, the Rosebel Group.

The sedimentary rocks at RGM range in provenance from undissected arc to transitional arc, to recycled orogen. This is probably reflective of contemporaneous erosion of different source material. A unique and not obviously correlative rock sequence is present in the turbidites of the north-trend, and this probably represents an earlier phase of deposition in a pelagic environment, that was later juxtaposed with the younger rocks to the south, through thrusting. The sequence most likely represents: (1) The formation of an island arc system, related to the convergence of the West African and South American cratons; (2) deposition of volcanogenic turbidites in either forearc or back-arc basin positions; (3) continued convergence of the cratons, and the formation of thrust sheets and horizontal folds along the northern margin of the South American craton; (4) erosion of these thrust sheets and primary deposition of the basal conglomerates and wackes; (5) sinistral shearing and felsic plutonism.

The structure of the RGM property resembles a synclinorium, about 30 kilometers wide, and trending 110°. The northern limb of the synclinorium is delineated by the hill-forming rocks of the north trend, and the southern limb is thought to be delineated by the hill-forming rocks of Brownsberg, approximately 18 kilometers southwest of the RGM property. The geometry of the rocks at RGM is indicative of at least three episodes of deformation, reflecting a changing stress regime during the Transamazonian Orogeny, resulting in folds, refolded folds, faulted folds, and folded faults. Most commonly, the rocks are isoclinally folded, with axial surfaces of folds striking parallel to the regional foliation (110°). Structural evolution of the RGM rocks is polyphase, and probably represents three deformational events: (1) Early thrusting and nappe-folding related to the initial stages of the Transamazonian orogeny; (2) Refolding of early nappe-style folds, and development of a penetrative axial planar foliation; (3) Sinistral strike slip deformation related to the final stages of the Transamazonian orogeny.

The rocks at RGM are analogous to a great number of Archaean and Proterozoic greenstone-belts described throughout the world. Examples from the Rio das Velhas greenstone belt in Brazil, the Birimian greenstone belts in west Africa, arc-related rocks in the Canadian shield, greenstone belts in India.