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NOTE ON THE COMPOSITION OF RIVER BANK SPRINGS, ROTOKAWA GEOTHERMAL FIELD

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INTRODUCTION

Natural thermal activity at Rotokawa, near Wairakei, is widespread and locally intense. Most of the hot springs and thermal features occur near Lake Rotokawa itself and along the Parariki Stream which drains it. The composition of these springs, the lake and the Parariki stream waters, have been analysed on several occasions (for example, Ellis and Wilson, 1961; Ellis and Mahon, 1977; Forsythe, 1977; Henley and Middendorff, 1985). These waters are of acid pH, have chloride and sulphate as their major anions and hence are classified as being of mixed composition in terms of the Ellis and Mahon (1977) classification.

Fluids discharged by geothermal drillholes at Rotokawa, by contrast, are of near neutral pH and of alkaline chloride type (Ellis 6 Mahon, 1977; Henley and Middendorf, 1985). However, waters of compositions different to both these types discharge along the northern and southern banks of the Waikato River, within the field, both east and west of the Fulljames Rapids. To our knowledge, there are no published analyses available of these waters although Mahon reported the composition of some in a DSIR internal report issued in 1960.

Because of the present interest in the Rotokawa Geothermal area, we here record the compositions of six of these springs.

THE SPRINGS

The springs, which discharge along the banks of the Waikato River, have long been known and are shown on the maps of Grange (1937), Gregg (1958) and others. However, most springs can only be seen and sampled when the river flow is low. Two of us made necessarily brief early morning visits to the north and south banks of the river in September 1986. We did not have time to make even a reconnaissance of, the entire thermal activity which has been shown by Gregg (1958) to extend along the Waikato River almost from its confluence with the Parariki Stream and point a few metres east of the entrance to the Ngaawapurua Reserve, a distance of about 3½km. On the south side of the river, however, we saw at least 25 individual discharge features; those measured had temperatures of between 65 and 90" and flow rates ranging from trickles to some in excess of 10 litres per second (visual estimate).

Their host rocks are Wairakei Breccia (Oruanui Ash); some of the springs discharge from narrow, northeast-striking joints. We could not smell any gas but noted very extensive silicification both here and on the north bank of the river. Four springs were sampled (Analyses 1-4; Table 1) on the south bank.

Hot springs also discharge on the northern bank of the Waikato River (analyses 5 and 6; Table 1); we counted 10 individual features over a distance of about 100m. Some discharge from within the Wairakei Breccia but others exit at the contact between this formation and the overlying fluviatile conglomerates. Flow rates range from trickles to twenty litres per second (visual estimate).

Undoubtedly there are many other discharge features in this area and below the river; gas bubbles are visible in many places. An obvious next step would be to sample the river up and downstream from the thermal features and deter mine the chloride input into the Waikato River.

Springs 1-4 are located on the south bank of the river and numbers 5 and 6 on its north bank; Spring 3 seems to match spring No.176 of Fisher and Dickenson (1960) and our spring number 5 his number 192. Springs occur between points 800m northwest and 1100m north north west of the site of drillhole RK1. This is in the area between a small north flowing stream and a location about 20m east of the pump jetty (see Djama, 1986).

Analytical Methods

1. Chloride, sulphate, silica, carbon dioxide and bicarbonate were analysed according to the methods described by Ellis, Mahon and Ritchie (1968).

2) Sodium, potassium and lithium were analysed by flame photometry using air-acetylene (respective wavelengths 589.0. 766.5, 670.8 nm); standard solutions contained only the elements to be analysed.

3) Magnesium was analysed by atomic absorption spectroscopy using an air-acetylene flame at 285.2nm.

4) Calcium was analysed by atomic absorption spectroscopy at 422.7 nm, using a nitrous oxide acetylene flame. Standard solutions contained only calcium. Samples were diluted to less than 5 mgl^{-1}.

5) Boron was analysed by the azomethine-H method described by (John, Chuah and Neufeld, (1975); their procedure was modified in that only 1ml of azomethine-H solution was used. Samples were diluted five fold.

We postpone comment and interpretations on the significance and chemistry of the springs as these points are presently being considered by Djama (1986); however, any hydrological model of the Rotokawa field clearly needs to take their presence into account.

Table 1: Composition of Springs Along the Banks of Waikato River at Rotokawa - (mg/kg)

Feature No	Field pH (paper)	Measured pH lab	T°C	Na	K	Ca	Mg	Li	HCO_3	Cl	SO_4	CO_2	SiO_2	B
1	6.8	7.41	84.5	270	22	23.0	1.4	2.1	226	309	72	9.9	144	11.4
2	7	6.57	90.0	380	32	30.0	0.8	3.0	173	477	103	28.7	182	16.3
3	6.7	7.79	70	350	30	24.5	0.76	2.1	294	367	78	5.9	206	12.1
4	7	7.74	89.5	335	35	24.8	0.07	2.7	83	438	121	0.0	224	14.7
5	7	7.08	65	210	21	12.8	0.63	2.4	282	155	59	14.8	260	2.9
6	7	7.30	71	215	19	11.5	0.63	2.4	315	144	33	8.9	236	2.7

REFERENCES

DJAMA, Khabar (1986): The geology and geochemistry of a portion of the Rotokawa geothermal field. Geothermal Institute Project Report No. 86.11 (in preparation).

ELLIS, A.J., MAHON, W.A.J. and RITCHIE, J.A. (1968): Methods of collection and analysis of geothermal fluids. DSIR report, C.D. No 2103.

ELLIS, A.J., WILSON, S.H. (1961): Hot spring areas with acid-sulphate chloride waters. Nature, 191, No. 4789, pp 696-697.

FISHER, R.G. and DICKENSON, D. (1960): The natural heat flow from the Rotokawa area. Unpublished DSIR report, TSG.lO.

FORSYTH, D.J. (1977): Limnology of Lake Rotokawa and its outlet stream N.Z. Journal of Marine and Freshwater Research, 11(3): pp 525-39.

GRANGE, L.I. (1937): The geology of the Rotorua-Taupo subdivision. N.Z. Geological Survey Bulletin, Nos: 37, 138.

GREGG, D.R. (1958): Natural heat flow from the thermal areas of Taupo Sheet District (N94). N.Z. Journal of Geology and Geophysics 1(1), pp 65-75.

HENLEY, R.W. and MIDDENDORF, K.I. (1985): Geothermometry in the recent exploration of Mokai and Rotokawa geothermal fields, New Zealand. Trans. Geothermal Resources Council, 9, Part 1, pp 317-324.

JOHN, M.K. CHUAH, H.H. and NEUFELD, J.H. (1975): Application of improved azomethine-H method to the determination of boron in soils and plants. Analytical Letters 8(8), pp 559-568.

MAHON, W.A.J. (1960): Chemistry Division, Open File Report No. DL 118/12 - WAJM 4. NZ DSIR Wellington.