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Technical Note

A note on the distribution, levels and temperatures of minewaters in the Northumberland and Durham coalfield

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Abstract

This Technical Note presents basic data on water levels, extraction rate and temperatures of minewaters in the Northumberland and Durham Coalfield. The data were collected during a survey of the coalfield undertaken for British Gas who have an interest in utilizing groundwater sources for heating gas at pressure reduction stations.

Introduction

Apart from the obvious importance to mining operations, information on minewaters is of interest as shown recently by Leoni (1985) for district heating and by Aldous, Smart & Black (1986) for groundwater management in coalfield areas. This Technical Note presents data on the water levels, extraction rates and temperatures for the Northumberland and Durham Coalfield. As shown in Fig. 1, this coalfield covers a roughly triangular area of some 2000 km^2 in northeast England, bounded by Amble (NU 265045) in the north, Barnard Castle (NZ 050165) in the southwest and Blackhall (NZ 455395) in the southeast. Deep mining activity is now concentrated in the east of the coalfield, in collieries located on the northeast coast. Here productive coal seams occur in the Lower and Middle Coal Measures, a sequence which is over 700 m thick (Taylor *et al.* 1971). These strata have been folded into a broad, irregular structural basin which extends offshore and has its deepest part near the mouth of the River Wear. In the southeast gently dipping Permian strata unconformably overlie the Coal Measures to form the concealed part of the coalfield.

British Gas have a particular interest in the use of groundwater sources for heating gas at pressure reduction stations; the information presented in this Note is taken from a more detailed survey of minewaters in the northeast coalfield. The Technical Note does not attempt to discuss the full implications of the preliminary work but is presented simply to record the basic observations made during the initial study.

The system of flooded workings in the coalfield

Abandoned workings occur over much of the coalfield and are probably present in all seams over about 0.6 m thick. The workings are extensive and may interconnect over distances of up to 50 km (Norton 1983).

On the basis of water levels the coalfield can be broadly divided into three different zones (Fig. 1).

(i) The eastern coastal area where in working mines water levels are maintained by pumping at the level of the deepest workings.
(ii) The perimeter of the working mines where controlled 'ponds' in abandoned mines are maintained by pumping below the overflow points into working mines to protect them from down dip flows.
(iii) The western area where abandoned mines are not pumped and levels are governed by overflow points into adjacent workings and ultimately into the controlled ponds or to surface issues.

The term 'ponds' refers to a hydraulic unit of interconnected, flooded mine workings with a complex, three-dimensional form where water rest levels do not necessarily follow a systematic or readily predictable pattern of variation. Individual ponds may be connected or isolated depending on the occurrence of barriers or linkages which relate to the geological conditions and past mining procedures. An average of some 3000 $m^3 h^{-1}$ of water is pumped from operational deep mines in the coalfield whilst a further 6300 $m^3 h^{-1}$ of water are pumped from shafts at abandoned collieries around the perimeters of the worked areas. In areas where pumping has ceased the ponds will eventually fill until minewater levels return more or less to the water table levels which existed prior to mining.

Survey data

Information on water levels and the distribution of pumping and observation shafts collected as part of a

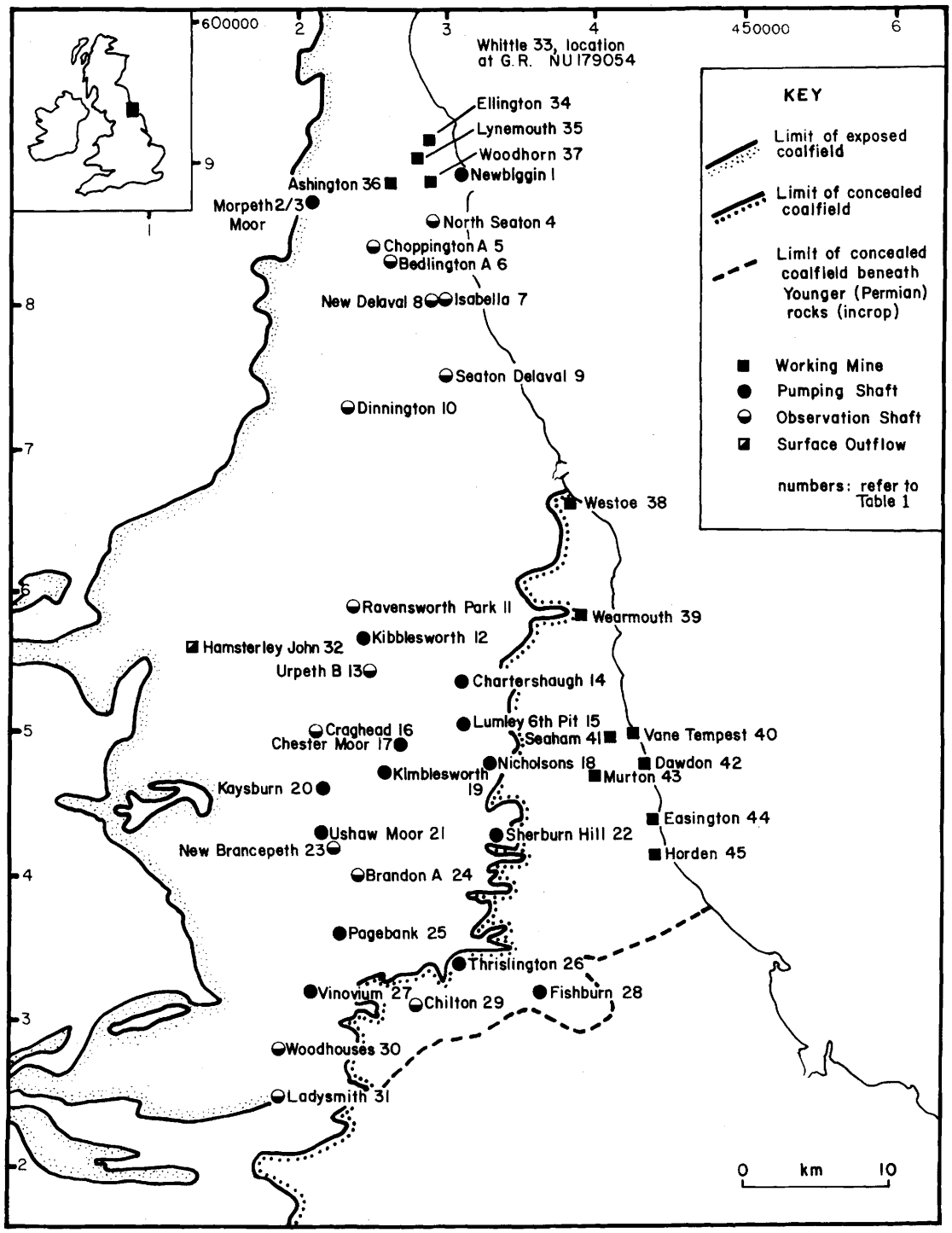

FIG. 1. A sketch map showing pumping stations, observation shafts and working mines in the Northumberland and Durham coalfield.

TABLE 1. *Northumberland & Durham coalfield: water levels, flows and temperatures, pumping stations, observation shafts and working mines*

Shaft name		Type	Nat. Grid. Ref.	Surface level (m) w.r.t. OD	Water level (m) w.r.t. OD	Water temp (°C)	Flow ($m^3 h^{-1}$)
Abandoned collieries							
Newbiggin	1	PS	NZ309888	+11	−178.4	—	160
Morpeth Moor (1)	2	PS	NZ211869	+61.3	−19.8	—	100
Morpeth Moor (2)	3	PS	NZ211869	+61.3	−19.8	—	
North Seaton	4	OS	NZ289858	+20.7	−196	12.0	—
Choppington A	5	OS	NZ250842	+30	−155.6	14.5	—
Bedlington A	6	OS	NZ272830	+31.4	−162.3	13.5	—
Isabella-Blyth	7	OS	NZ298805	+15.25	−207	—	—
New Delaval	8	OS	NZ291802	+26.5	−99	14.0	—
Seaton Delaval	9	OS	NZ300750	+38	−80.5	13.5	—
Dinnington	10	OS	NZ232728	+69.8	−55.5	—	—
Ravensworth Park	11	OS	NZ241589	+25.6	−75.3	—	—
Kibblesworth	12	PS	NZ246565	+73.5	−85.4	16.0	1070
Urpeth B	13	OS	NZ255542	+82.7	−57.6	13.0	—
Chartershaugh	14	PS	NZ309536	+7.5	−97.6	16.4	80
Lumley 6th	15	PS	NZ310507	+50	−94.6	14.4	120
Craghead	16	OS	NZ212505	+202	+23.5	—	—
Chester Moor	17	PS	NZ269493	+50.6	−54.9	15.0	360
Nicholsons	18	PS	NZ329483	+58.6	−77.8	14.5	130
Kimblesworth	19	PS	NZ261469	+87.6	−56	13.5	380
Kayburn	20	PS	NZ220462	+103.4	+0.6	13.9	100
Ushaw Moor	21	PS	NZ220429	+111	+14	12.6	320
Sherburn Hill	22	PS	NZ335428	+117.7	−53.4	13.5	260
New Brancepeth	23	OS	NZ225420	+100.6	+17	14.0	—
Brandon A	24	OS	NZ243400	+104	+19	11.0	—
Pagebank	25	PS	NZ231358	+52.8	+7	13.3	490
Thrislington*	26	PS	NZ309339	+128	+67	—	—
Vinovium	27	PS	NZ210321	+647	+13.7	13.0	900
Fishburn*	28	PS	NZ360320	+98.6	+62.5	13.3	60
Chilton	29	OS	NZ278307	+131	+70	11.7	—
Woodhouses	30	OS	NZ189281	+143	+103	—	—
Ladysmith	31	OS	NZ195254	+114.7	+107	—	—
Hamsterley John	32	MI	NZ129570	+60	+60	—	450
Working collieries							
Whittle	33	WM	NU179054	+137	−6	—	100
Ellington	34	WM	NZ287916	+15	−116	—	390
Lynemouth	35	WM	NZ297905	+15	−107	—	140
Ashington	36	WM	NZ266885	+30	−129	—	140
Woodhorn	37	PS	NZ288884	+30	−202	—	90
Westoe	38	WM	NZ373666	+15	−425	—	425
Wearmouth	39	WM	NZ391581	+25	−570	—	80
Vane Tempest	40	WM	NZ426503	+25	−555	—	2
Seaham	41	WM	NZ411496	+69	−395	—	8
Dawdon	42	WM	NZ437477	+38	−450	—	70
Murton	43	WM	NZ402470	+99	−346	—	90
Easington	44	WM	NZ438442	+65	−309	—	410
Horden	45	WM	NZ442416	+55	−299	—	1700

PS, pumping stations; OS, observation shaft; MI, mine issue; WM, working mine
* These pumping stations are in operation for water supply.

recent survey undertaken for British Gas, are presented in Table 1. These data should be considered as giving only an indication of the broad variations which exist. In Durham (the southern half of the coalfield), the levels generally follow a west–east fall, being deepest in the working mines at 299 to 570 m below OD (Ordnance Datum). The water levels in the pumping and observation shafts around the perimeters of the worked areas (11, 12, 13, 14, 15, 17, 18, 19 and 22) have higher levels at 53 to 97 m below OD whilst most westerly shafts (16, 20, 21, 23, 24, 25, 27) have levels 0.6 to 23.5 m above OD. The levels south of the Butterknowle Fault (26, 28, 29, 30 and 31) are at 62 to 103 m above OD and it is likely that high levels also occur to the west of the county; unfortunately, little data are available for this area.

Whilst the levels are essentially stable in Durham, in Northumberland (the northern half of the coalfield) pumping has recently ceased in the Blyth area following the closure of Bates Colliery and water is rising in some of the observation shafts.

Twenty-one mine shafts were visited and water temperatures were measured either by lowering a maximum–minimum thermometer down the shaft or measuring the temperature of the water pumped to the surface. Where both methods were used similar results were obtained. The data summarised in Table 1 indicate that water temperatures tend to be higher in the pumped shafts than in the observation shafts.

When the temperature measurements were taken, surface water temperatures were 10°C. Whilst most of the shaft readings are consistent with normal groundwater temperatures, at about 11°C, some show significant enhancement. At Kibblesworth and Chartershaugh (Table 1) the measurements were in the order of 16°C, the highest figures recorded during this survey. The proximity of these particular locations to the Weardale granite is of note, in view of the recent interest in the high heat flow associated with this intrusion (Downing & Gray 1986).

Conclusions

Minewaters in the Northumberland and Durham Coalfield occur at temperatures between 11 and 16°C. They consequently represent a large, low-temperature, heat source which could be exploited by pumping the water up to surface heat pump systems or by using heat pumps in conjunction with down hole heat exchangers; the latter currently being evaluated for use in abandoned mine workings in the U.S.A. (Karvelas, Kaminsky & Peters 1985). Indeed if during a heating application the water temperature can be reduced by 5°C then the water currently pumped from the working and abandoned mines in the coalfield represents a heat source of 50 MW.

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