ACARP

FINAL REPORT

Outbursting
Scoping Study

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9.2.2 ΔP_{0-60} Index

Ettinger et al (1953) defined the ΔP_{0-30} value and later the ΔP_{0-60} value (Lidin et al, 1954).

The modification of the ΔP_{0-60} index for field studies has been used in a number of countries for the estimation of liability to outbursts of an advancing face. The method consists of drilling holes 3 m deep in a development heading. On a longwall face, the holes must be drilled every 15 m. A coal sample is extracted from the depth of 2.5 - 3 m and sieved. In bituminous coal, the particle size collected is 0.25 - 0.5 mm and in anthracite coal, the particle size collected is 2 - 3 mm. A 3 g of the sample is enclosed in a sealed chamber within 90 s of the drilling and change in gas pressure in mm of Hg is measured on elapse of 10 and 60 seconds. The ΔP values calculated are

$$\Delta P_{0-10} = P_{10} - P_0 \qquad\qquad (9.1)$$
$$\Delta P_{10-60} = P_{60-0}$$
$$\Delta P_{0-60} = \Delta P_{0-10} + \Delta P_{10-60}$$

where P_0, P_{10} and P_{60} are pressures developed in mm of mercury (Hg) at times equal to 0, 10 and 60 seconds.

The arrangement of holes is given in Fig. 9.5.

The critical value of ΔP_{0-60}, >15 mm Hg (~20 mbars) is taken as a sign of an imminent outburst. An automatic measurement system has been developed for the determination of this value under field conditions. The method has been used in seams with predominantly methane gas in Ibbenbüren Colliery in anthracite coal and in Belgian coal mines who were the first to adopt it on a regular basis (Vandeloise, 1964).

ΔP_{0-60} index can vary widely within the coal seam. Fig. 9.6 shows an example of the ΔP_{0-60} value for a coal seam (Janas and Winter, 1977).

The highest value is 26 and the lowest 5. Dull coals show the highest value - possibly due to their lowest diffusivity. The value is reduced by increase in ash and the modified value to account for ash is given by

$$\Delta P_{0-60} \ (AFB) = \frac{\Delta P_{0-60}}{(1 - ash \ \%)} \qquad (9.2)$$

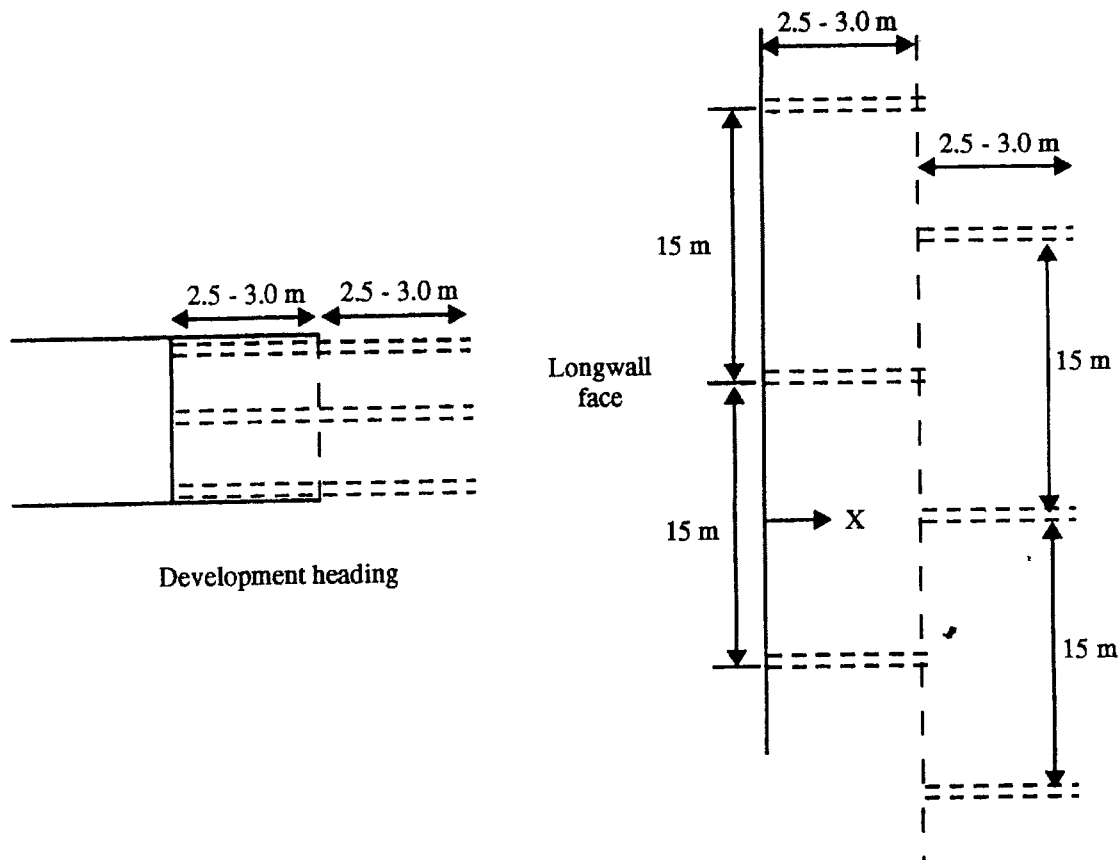ΔP_{0-60} value cannot be evaluated for moist coals.

Fig. 9.5. Placement of holes for sampling for ΔP_{0-60} determination.

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$\Delta P_{0\text{-}60}$ value has been found to depend upon the depth of the borehole and structure of coal. Fig. 9.7 shows the effect of depth (increased stress and gas) (Paul, 1977) on the $\Delta P_{0\text{-}60}$ value. Pulverised coal or coal from shear zones also show high $\Delta P_{0\text{-}60}$ values.

Roof		Coal lithotype		$\Delta P_{0\text{-}60}$ Index
	43	bright coal		8
				8
	8	bright coal		5
	2	shale band		
	4	bright coal		
	2	dull coal		26
	34	bright coal		7
	3	dull shale coal		14
	10	bright coal		8

Floor

Fig. 9.6. Variation in $\Delta P_{0\text{-}60}$ in Gemini seam, Leichhardt Colliery (Janas and Winter, 1977).
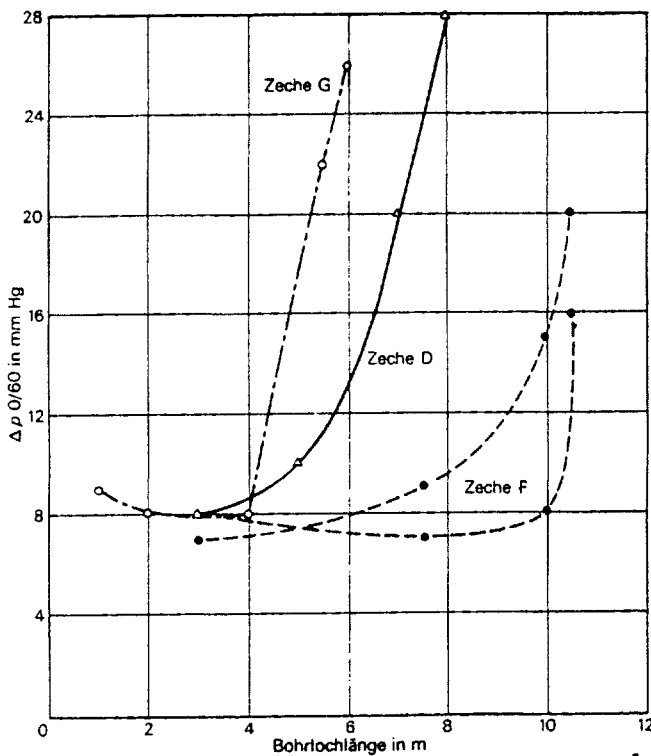

Fig. 9.7. Effect of borehole depth and structure of coal on $\Delta P_{0\text{-}60}$ value (Paul, 1977).
Zeche = seam; Bohrlochlänge = borehole depth
Einfacher Überlagerungsdruck = stress, equal to vertical load
Dreifacher Überlagerungsdruck = stress, 3 times the vertical load.

There is a definite relationship between $\Delta P_{0\text{-}60}$ and $\Delta P_{10\text{-}60}$. The shape is a steep parabola such that (Fig. 9.8)

$$\Delta P_{10\text{-}60} = 1.62 \, (\Delta P_{0\text{-}60})^{0.67}$$

Fig. 9.8. Relationship between $\Delta P_{0\text{-}60}$ and $\Delta P_{10\text{-}60}$. (Vandeloise, 1964).
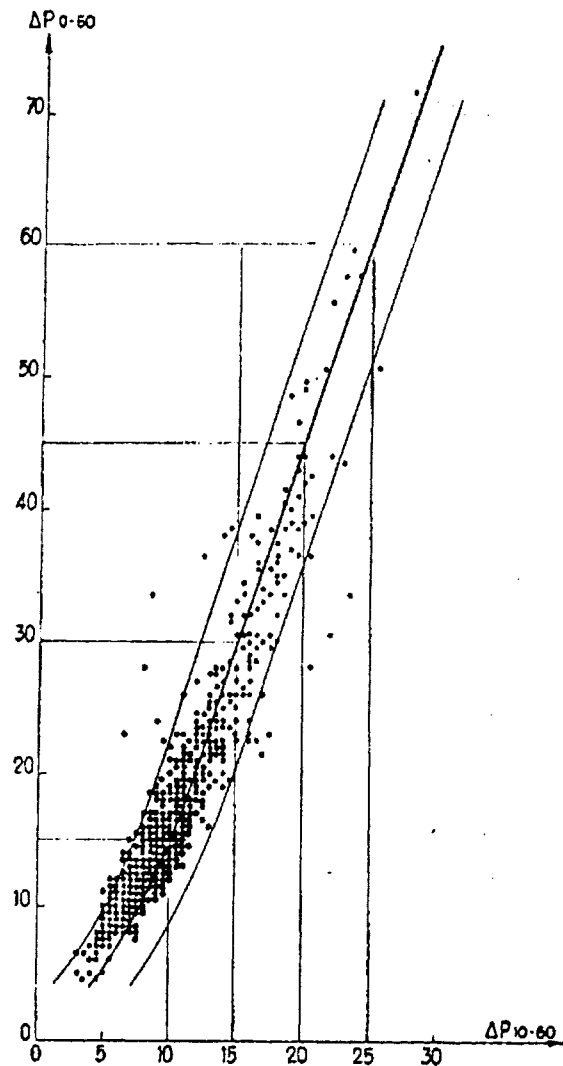
Belgian classification using ΔP indices is given in Table 9.3.

Table 9.3. Belgian classification of ΔP indices (Vandeloise, 1964)

$\Delta P_{10\text{-}60}$	$\Delta P_{0\text{-}60}$	Degree of danger	Fissuration class
0 - 10	0 - 15	Coal not prone to outbursts	Class 2 & lower 3
10 - 15	15 - 30	Slightly suspect	Class 3 & lower 4
15 - 20	30 - 45	Suspect to outbursts	Class 3 & 4
20 - 25	45 - 60	Dangerous	Class 3 and upper 4
>25	>60	Highly dangerous	Class 4 & 5

Vandeloise (1964) identified $\Delta P_{0-60} = 20$ as the lower limit of outburst danger. In Cevennes coal field this limit was found to be about 14 with 43% of the values lying above 14. In highly outburst prone seams, 65% of the values lie above 14. ΔP_{0-60} values have been found to relate very roughly to the fissuration in the coal seams (Table 4.6).