THE IMPORTANCE OF CONTINUING VOCATIONAL TRAINING OF OCCUPATIONAL HEALTH AND SAFETY IN COAL PRODUCTION OF THE NORTHWESTERN ANATOLIA COAL BASIN (TURKEY)

Ibrahim BUZKAN, Bülent Ecevit University,
Engineering Faculty, Department of Geological Engineering
Zonguldak 67100, TURKEY
buzkan_ibrahim@yahoo.com

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1. INTRODUCTION

The Northwest Anatolian Coal Basin (Turkey) covers an area of approximately 13,500 km2 at the Black Sea coast. The Carboniferous period coal reserve in the 45 coal seams in the Alacaağzı, Kozlu and Karadon formations is estimated to be 1,00x109 t. Since 1941, amounts varying between 2,200x106 t and 8,545x106 t of industrial and coking coal are being mined in elevations extending from outcrops to a depth of -540m. Coal is mined by the Turkish Hardcoal Enterprise (TTK) with the underground progressive longwall method in panels at elevation intervals of 100 m. So far, the TTK has dug tunnels of a total of 450 km in the coal bearing strata for coal production. The Enterprise has employed a total number of surface and underground workers varying between 10,533 and 43,594 during the years 1961-2010.

- Asıl metin stillerini düzenlemek için tıklatın
  - İkinci düzey
    - Üçüncü düzey
      - Dördüncü düzey
        - Beşinci düzey

Location map of the study area.

1.2. Geological Structure

Even though the coal production in the basin began in late 1800s, the basin has not been adequately resolved in terms of geologic and tectonic systematic. In other words, the cyclothems of coal seams have not fully revealed. Casualties and deaths occur in excavations of preparation wells and galleries in coal bearing rocks of the basin that is extremely affected by Hercynian and Alpine Orogenesis tectonics, as a result of roof collapse, and also in preparation and production of coal seams resulting from roof collapse and slump and sudden degassing. The organic and inorganic maturation of the basin is in diagenesis-ankimetamorphism zone. Maceral abundance in the coal seams is generally in vitrinite, inertinite and exinite. However, inertinite and exinite are dominant in some coal bands in which gas formation and deposition increase and also density of gas deposition increase with depth factor. These seams have a capacity of thousands of cubic meters of gas deposition.

The area contains bituminous types of coal; uncoking, semi coking and coking containing medium and high amounts of volatile substances. Of the detritus sedimentary rocks containing these types of coal, the Alacaağız Formation is 650 m thick, the Kozlu Formation 700 m thick and the Karadon Formation 650 m thick. Lithologically, the coal and coal bearing strata in these formations are formed by the intercalation of layers of conglomerate, sandstone, siltstone, claystone, shale, coaly shale and coal. The coal bearing strata in the field is located in the diagenetic-anchimetamorphic zone. These strata consist of semi-angular and semi-spherical quartz, magmatic rock fragments and feldspar minerals. The quartz percentage of the coal bearing strata goes from 25 % to as much as 77 %. The coal seams are divided into bands with layers of sandstone, siltstone, claystone, shale, and coaly shale. The coal ash in these seams ranges from 10% to 67 % and they also contain 37-62 % of SiO2.

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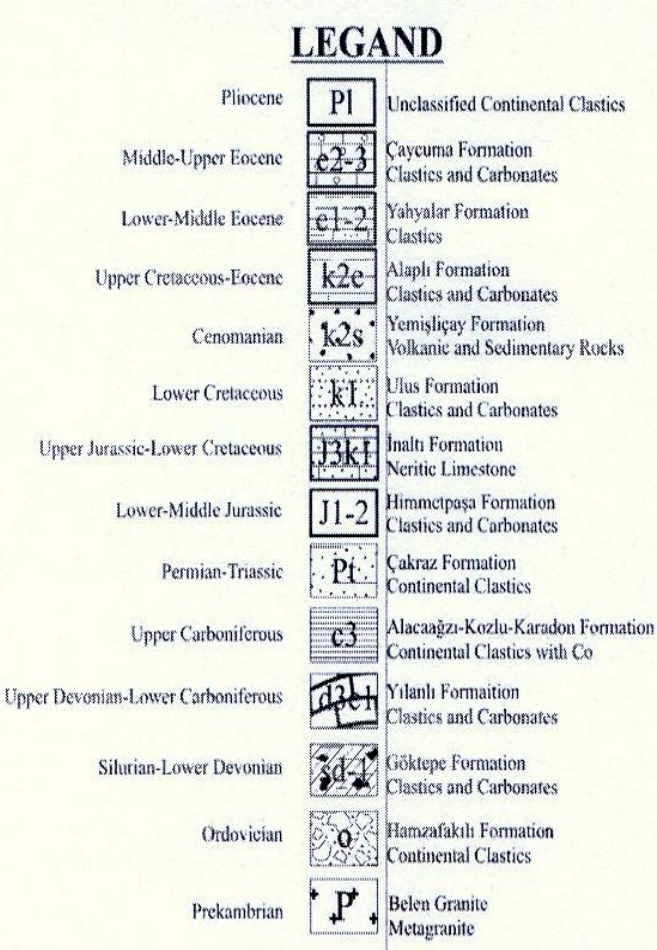
kinci düzey

Üçüncü düzey

Dördüncü düzey

Beşinci düzey



Geological map of the study area

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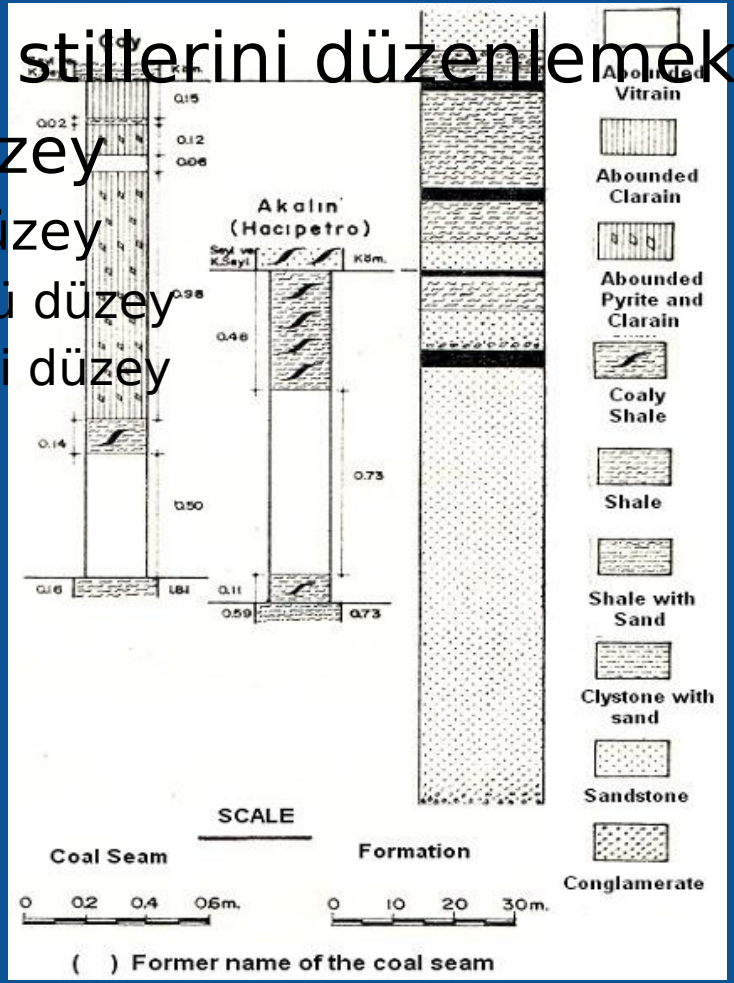
These strata consist of semi-angular and semi-spherical quartz, magmatic rock fragments and feldspar minerals. These minerals have cemented with clay, silica and organic matter. The coal seams were formed in bands in paralic environments and cleat sets developed in two directions. The cleats were found to be full of minerals such as clay, pyrite and marcasite. The coal seams are divided into bands with layers of sandstone, siltstone, claystone, shale, and coaly shale. Some coal seams store very much methane gas in the cells of the macerals like inertinite.



1.3. Coal Production in the Northwestern Anatolian Coal Field

Coal mining in this field is done by progressive longwall method to a depth of -540m in layers at 100m intervals. Here, the coal seams are reached through rack up galleries with a cross section of (10m2-12m2-14m2) dug using the central break up blast method in the coal bearing strata and the coal production is done progressively by longwalls formed by galleries opened in the coal seam. There are angular broken quartz and rock grains in the inhalable dust of 0-5 μ formed during blast mining using the central break up method. While a maximum of 77% of quartz is found in the coal bearing strata, the quartz amount in the inhalable dust produced during mining process can attain to 85% depending on the type of rock. Factors determining this are; the blasted rock and the humidity level of the environment, mineralogical characteristics, grain size, degree of roundness, brittleness of the quartz minerals and the uniaxial compression resistance of the strata.

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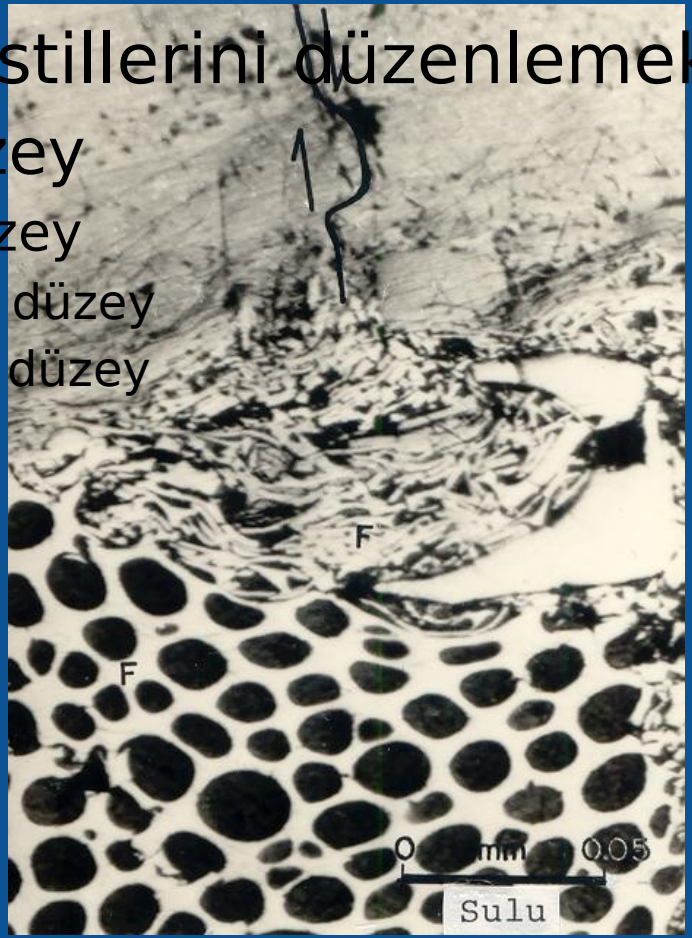
Vitrinite maceral and cells of the fusinite maceral (full methane gas), tectonic fracture of Sulu seam composition at Kozlu Formation in the Norhwestern Anatolian Coal Basin (Turkey).



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Vitrinite maceral and exinite maceral of Kurul seam composition at Kozlu Formation in the Norhwestern Anatolian Coal Basin (Turkey).

Sample Name		Lithology	Quartz Contents (%)	Grain Size	Sphericity	UCS (MPa)
Kartal	Roof	F Sandstone	74	60-200µ: %82	SA: %68	101.7
	Floor	M Sandstone	72	200-600µ: %85	SA: %73	113.8
Yiğit	Roof	M Sandstone	75	200-600µ: %80	SA: %79	128.6
	Floor	M Sandstone	71	200-600µ: %82	SA: %74	109.4
Büyük	Roof	F Sandstone	76	60-200µ: %88	SA: %85	121.2
	Floor	M Sandstone	72	200-600µ: %84	SA: %75	118.5
Dibek	Roof	M Sandstone	66	200-600µ: %84	SR: %59	96.5
	Floor	F Sandstone	37	60-200µ: %56	SR: %82	45.4
Sulu	Roof	Siltstone	38	31-60µ: %58	SA: %52	82.8
	Floor	M Sandstone	65	200-600µ: %55	SA: %90	102.8

C: Coarse,

M: Medium,

F: Fine,

VF: Very Fine,

OM: Organic Matter,

SA: Slightly Angular,

SR: Slightly Rounded,

UCS: Uniaxial Compressive Strength

Sample Name		Lithology	Quartz Contents (%)	Grain Size	Sphericity	UCS (MPa)
Nasıfoğlu	Roof	VF Sandstone	35	60-200μ: %65	SA: %80	136.7
	Floor	F Sandstone	57	60-200μ: %99	SA: %88	143.8
Acılık	Roof	M Sandstone	66	200-600μ: %62	SA: %90	107.7
	Floor	Siltstone	32	60μ> : %60	SA: %65	95.6
Çay	Roof	M Sandstone	66	200-600μ: %62	SA: %91	127.0
	Floor	F Sandstone	58	60-200μ: %66	SA: %90	90.3
Akalın	Roof	M Sandstone	61	200-600μ: %76	SA: %55	90.9
	Floor	VF Sandstone	55	60-200μ: %70	SR: %60	64.5
Gökcan	Roof	F Sandstone	68	60-200μ: %73	SA: %92	94.3
	Floor	M Sandstone	75	200-600μ: %79	SA: %67	128.7

C: Coarse,

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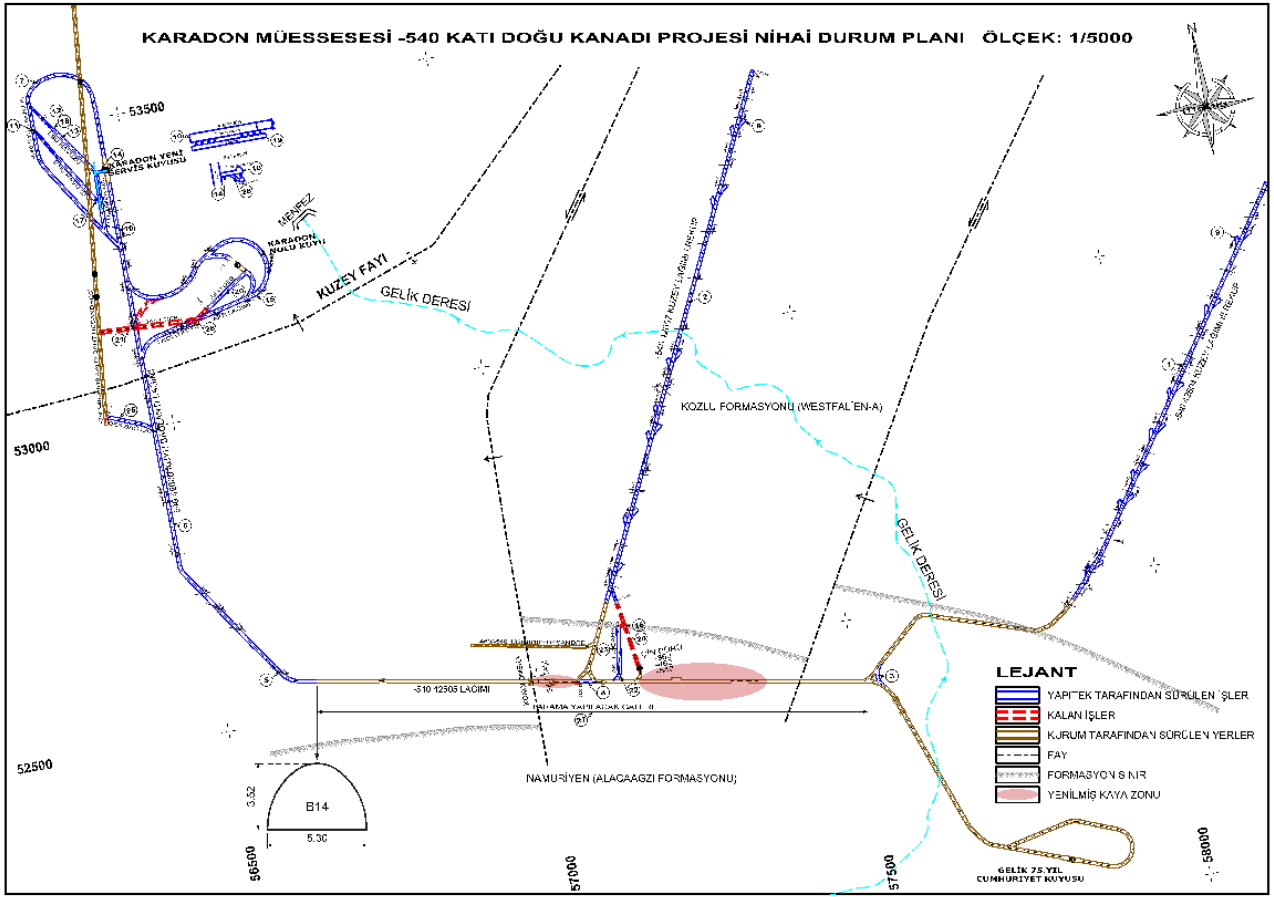
The macropore volume, micropore volume and surface area of Carboniferous bituminous coals in Northwestern Anatolia Turkey varies with rank and maceral compositions. Helium and mercury densities of the coals vary between 1.28–1.41 and 1.11–1.32 g/cm3, respectively. The macropore volume determined by mercury porosimetry varies between 0.0065 and 0.0687 cm3/g. The micropore volume and respective micropore surface area values are ranging from 0.0139 to 0.0524 cm3/g and from 42 to 160 m2/g, respectively. The Langmuir monolayer volume, which can be considered as an estimate of the gas adsorption capacity varies between 14 and 37 cm3/g. The corresponding specific surface area values range from 80 to 216 m2/g. A comparison of pore volumes with rank and maceral composition of coals indicated that micropore volume decreases with increasing maturity up to a value of 1.0%Ro and then increases with further increase of coal rank.

The fracture structure of three coal seams (Sulu, Acılık and Cay) in the coal field of Northwestern Turkey from two different seams have been analysed in relation to coalbed methane recovery. Acılık and Sulu coals seem to be structurally more prone to be commercially productive. These coals show a high degree of fracturing and cleat development as evidenced by X-ray CT and light microscopy examination of polished surfaces. Although the Cay coal seams shows a high fracture density, the cleat surface morphology and smaller fracture apertures may make this coal unfavourable for gas flow.

2. WORK ACCIDENTS

Investigations show that some of the most crucial reasons for the casualties and deaths in work accidents in the Northwest Anatolian Coal Basin of Turkey can be attributed to the facts that the geologic and tectonic structures are complex and negligence in caring for petrographic structure. Coalfield in northwest Anatolia occurred in May-2010, 30 miners died in work accidents degassing. This working 2 of the mining engineer, the others are mine worker. The newly released accident at work on a gallery on the fault lines in areas with the limit values has been on the gas output. In May 2010 fatal occupational accidents occurring in the -540 level Karadon Region Karadon New Service Well connection point with the 75th Anniversary of the Republic of Gelik Well gallery location on the map in figure 4 is located.


KARADON MÜESSESESİ -540 KATI DOĞU KANADI PROJESİ NİHAİ DURUM PLANI ÖLÇEK: 1/5000
53500
KARADON YENİ SERVİS KUYUSU
MENFEZ
KARADON ESKİ KUYU
KUZEY FAYI
GELİK DERESİ
KOZLU FORMASYONU (WESTFAL'EN-A)
GELİK DERESİ
53000
52500
-510 12505 EĞİMİ
NAMURİYEN (ALACAAĞZI FORMASYONU)
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GELİK 75.YIL CUMHURİYET KUYUSU
LEJANT
YAPILMASI TARAFINDAN SÜRÜLEN İŞLER
KALAN İŞLER
KURUM TARAFINDAN SÜRÜLEN YERLER
FAY
FORMASYON SINIR
YENİLMİŞ KAYA ZONU

In this study, the reasons for occupational hazards in employees of the Turkish Northwest Anatolian Coal Basin can be given as follows;

- Geological structure of the coal bearing formations, floor and roof rocks (laminated roof rocks, immediate roof rocks and clay minerals, mineral and maseral components) and intersection rocks of coal seams,
- Tectonic effects of the coal bearing formations (effect of Hercynian and Alpine Orogenesis, folding, faults, channel deposits, gas contents in coal)
- Maturation of the coal bearing formations and maturations of the coal seams (diagenesis of surround coal bearing rocks and coals), metamorphism (anchimetamorphic zone),
- Control deficiency in the enterprise (difficulties in enforcing and updating laws, regulations, instructions; not caring for those; favouritism, political influences and sanctions),

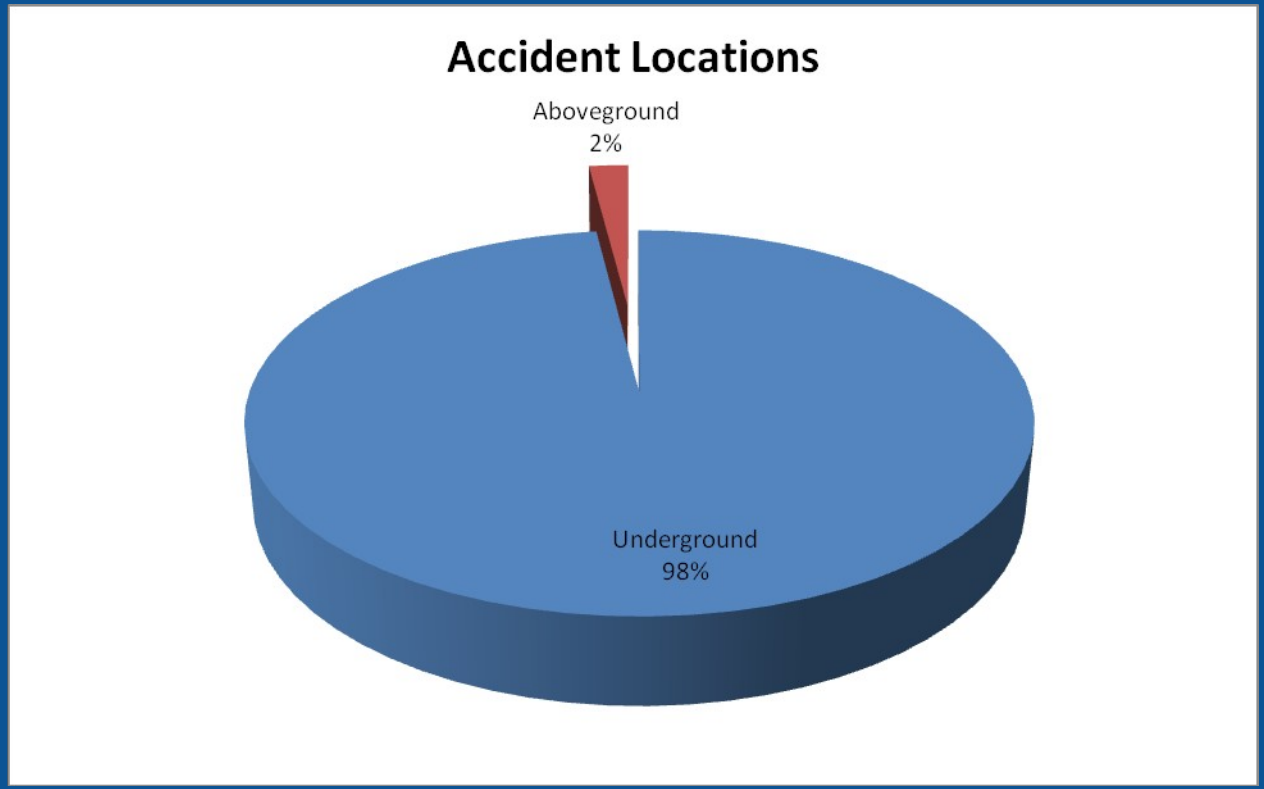
- Education levels of the employees and deterrence for duty negligence (insufficient period of education for the employees, managers to act as a political, lack of professional skills and work experience about underground mining),
- Lack of knowledge and technical equipment's (research inadequacy of the employees, not implementing their knowledge and experience; being deprived from current technical developments),
- Inadequacy of the administrators (assignment of inadequate administrators by the politicians in line with their political aspirations),
- Not adopting modern gallery sections for coal production and preparation (problems arising from using modern mechanized excavation systems in traditional excavation areas),
- Utilizing excavation and production techniques based on human labor (applying mostly human labor intensive excavation, preparation and production methods, low level of mechanization),
- Underground ventilation conditions and the current communication, the hardware level and the lack of adequate information about the use of information systems, lack of education on these issues.

- This kind of underground mines containing gas, which had been the location of accidents, occupational health and security as a continuous chronological history of the handle into the brains of employees.

For these reasons the casualties and deaths occur (roof collapse, support materials, auxiliary raw materials and transportation of the coal produced in accidents, gas choking, degassing, coal-mail that choking, rock falls from the ceiling of the foliated rocks and immediate roofs, transfer of coal, degassing, explosions of the methane gas in work) in the enterprise. The seams contain immediately done laminated roof rocks. Roof collapses and rock falls are occurring in these rocks that injured workers and sometimes deaths. Some coal seams contain very much methane gas in the cells of the macerals like inertinite. During the coal production gas choking, coal-mail that causes choking, degassing, explosions of the methane gas occurs in these seams.

3. IMPORTANCE OF CONTINUING VOCATIONAL TRAINING

The production of coal is carried out in 45 coal seams in the Northwest Anatolian Coal Basin of Turkey annually. The seams where coal is produced consist of coal bearing strata and coal seams that have different characters. Therefore, the technical and non-technical personnel who work both on surface and underground should have the adequate technical equipment and knowledge on coal production panels and coal seams in their working area. There should be adequate knowledge on the coal bearing strata, coal seams, geological, lithological and petrographical properties of each coal seam. Thus, the workplace safety of the personnel and work environment would be ensured.


Accident Locations
Aboveground
2%
Underground
98%

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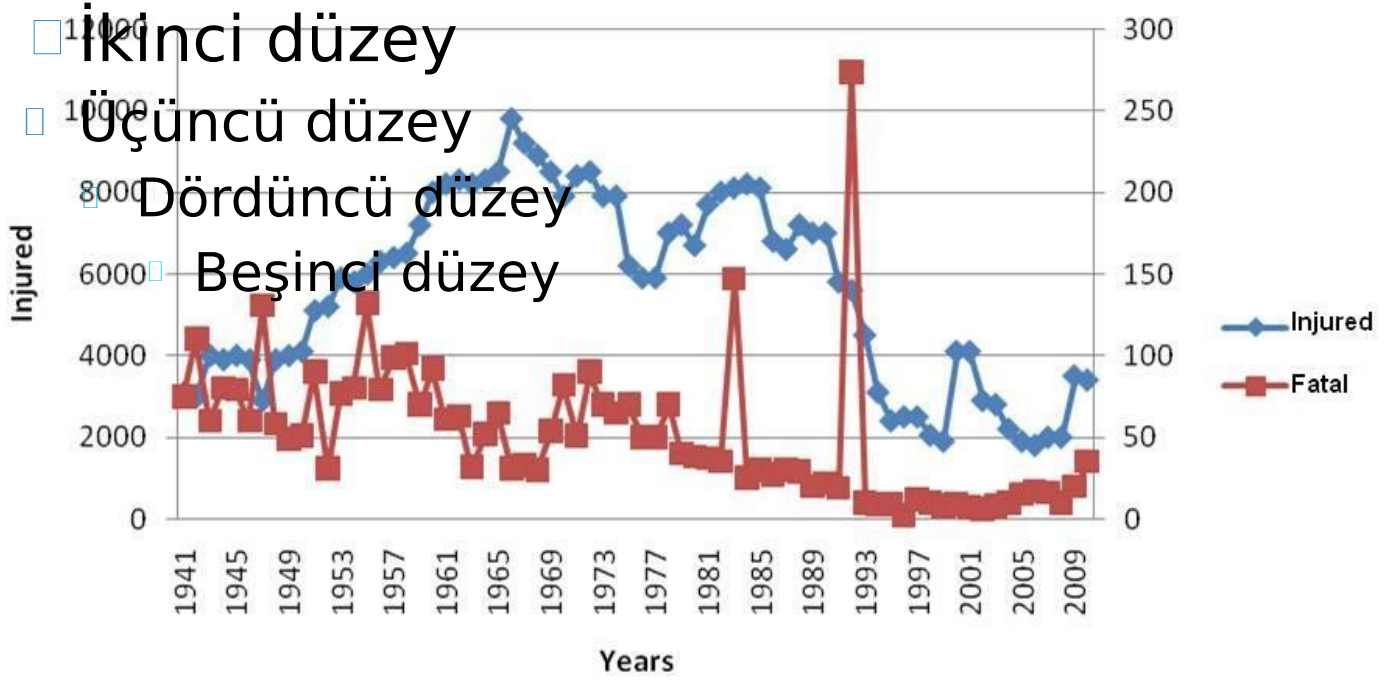

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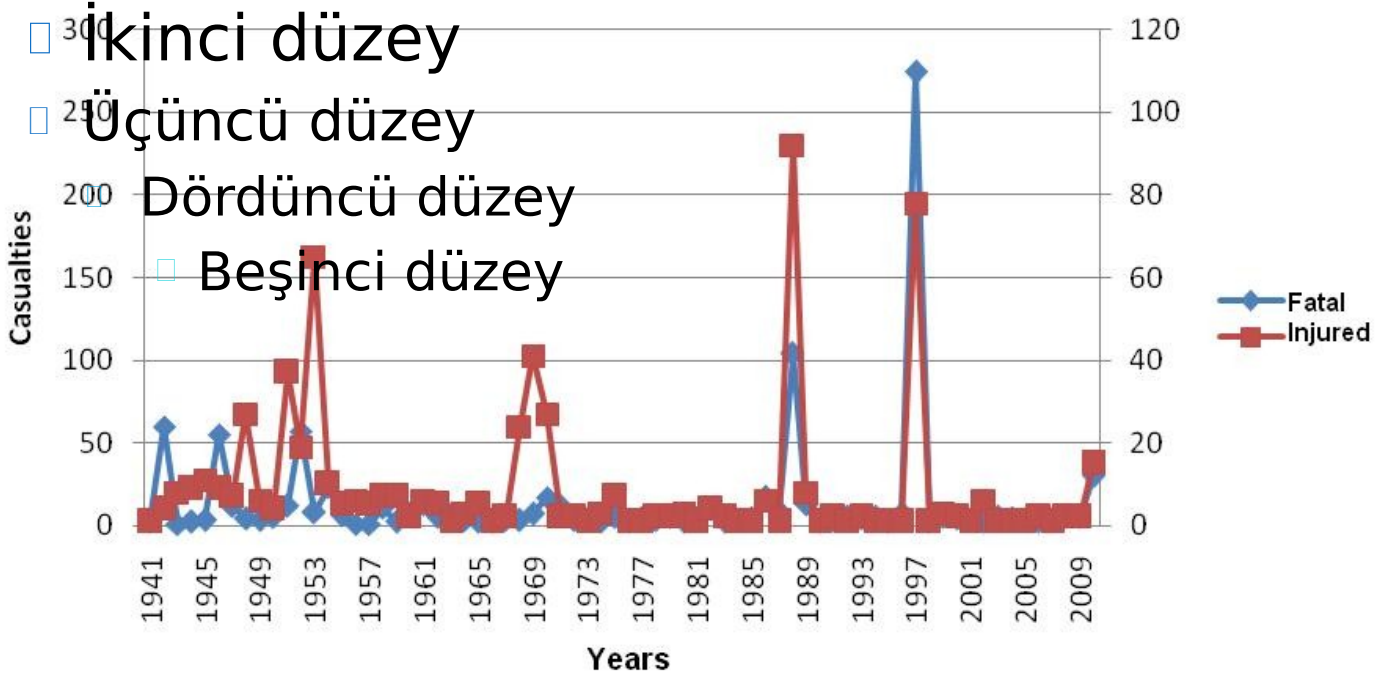

4. RESULTS

The reasons of the casualties and deaths occur (roof rocks and immediate roof rocks collapse, inadequate support materials, auxiliary raw materials and transportation of the coal produced in accidents, gas choking, coal-mail that choking, rock falls from the ceiling of the foliated rocks, transfer of coal, degassing, explosions of the methane gas in work) in the Northwestern Anatolian Coal Basin of Turkey. The seams contain immediately done laminated roof rocks. Roof collapses and rock falls are occurring in these rocks that injured workers and sometimes deaths. Some coal seams contain very much methane gas in the cells of the macerals like inertinite. During the coal production gas choking, coal-mail that causes choking, degassing, explosions of the methane gas occurs in these seams.

The technical and non-technical personnel who work both on surface and underground should have the adequate technical equipment and knowledge on coal production panels and coal seams in their working area. There should be adequate knowledge on the coal bearing strata, coal seams, geological, lithological and petrographical properties of each coal seam. Thus, the workplace safety of the personnel and work environment would be ensured.

Therefore, the preparation of all personnel working in galleries and coal production constantly evolves subject to the conditions and events in the vocational education needs to be held against. All employees have the working environment, work safety is important in terms of how much detail should be aware of. However, a more efficient working environment in this way, fewer accidents and injuries and death occur.


Thank you so much to everyone