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Data Base of Chemical Explosions in Kazakhstan

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**National Nuclear Center
of Republic of Kazakhstan
Institute of Geophysical Researches**

**DATA BASE OF
CHEMICAL EXPLOSIONS
IN KAZAKHSTAN**

**(report about a research works
upon the Agreement N B301622)**

Kurchatov c.

1996

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INTRODUCTION

Present report composed in accordance with Technical plan upon the theme " Data base on chemical explosions in Kazakstan " within the bounds of Agreement N B301622.

The total volume of present report is 131 pages. The report includes 4 chapters, 14 tables, 68 figures.

Within the bounds of report the following works were done :

1. Information about explosion quarries, located in Southern, Eastern and Nothern Kasakstan was summarized.

2. The general information about seismicity of areas of location of explosion quarries was adduced.

3. The system of observation and seismic apparatus, recording the local earthquakes and quarry explosions at the territory of Kazakstan were described.

4. Data base of quarry explosions, that were carried out in Southern, Eastern and Nothern Kazakstan during 1995 and first half of 1996 year was adduced.

5. Upon the data of registration of explosions in Southern Kazakstan the correlative dependances between power class of explosions and summary weight of charge were constructed.

6. Seismic records of quarry explosions were adduced.

It is necessary to note, that the collection of data about quarry explosions in Kazakstan in present time is very difficult task. Organisations, that makes these explosions, are always suffering reorganisations and sometimes it is actually impossible to receive all the necessary information. Some quarries are situated in remote, almost inaccessible regions,

and within the bounds of supplied financing not the every quarry was in succes to visit. So the present data base upon the chemical explosions for 1995 y. is not full and in further it's expansion is possible.

1. COMMON INFORMATION ABOUT QUARRY EXPLOSIONS.

At the territory of Southern, Eastern and Northern Kazakhstan annually is carried out the big number of chemical explosions for different economic needs (quarry, road, building and another explosions). The biggest explosion - makers is Government joint-stock company "Jarilis" (former Kazakh explosion industry) and Government joint-stock " Ekibastuskomir " (former group of enterprises of " Ekibastuscoal "). Below were described the explosion quarries, that belong to these two organisations, and also chemical explosions, that became known to us, that were carried out by different organisations and related with concrete building or another works.

1.1 Quarries of Eastern Kazakhstan.

In this paragraph described the quarries, that are situated on the territory of Eastern Kazakhstan and district of Semipalatinsk city, and they belong to the East-Kazakhstan territory administration of Government joint-stock company "Jarilis".

Quarry Novotaubinka is situated in 90 km by railway to south-east from Semipalatinsk city, near railway station Suikbulak. At the quarry the works for extraction of limestone for cement factory of Semipalatinsk city are carried out. Strictly speaking, Novotaubinka - it is two quarries, old and new, situated in the distance of 2 km one from another.

Configuration of explosions at the new and old quarries is different. Explosions are carried out in the holes, placed at the old quarry upon the quarter net with distance between holes 6 metres, and at the new - upon the rectangular net with distance between holes 2 metres in one direction and 2.5 metres in ortogonal. Coordinats of the old quarry - 49°47'40" of north latitude and 80°51'35" of east longitude. Co-ordinates of new quarry - 49°48'05" of north latitude and 80°52'50" of east longitude. During the period under review at the old quarry were carried out 25 explosions of difficult configuration - with great quantity of detonators and time stretching. All the information about these explosions was represented to us by organisation, making these explosions and was adduced in table 1.

Table 1. Data about chemical explosions, that were carried out during 1995 year and during first half of 1996 year at the old quarry of Novotaubinka.

Date	Total weight of charge,kg	Amount of holes	Depth of holes, m	Amount of detona-tors	Volume of exploded rock, m ³
26.01.95	16656	68	14.4	12	

Date	Total weight of charge,kg	Amount of holes	Depth of holes, m	Amount of detonators	Volume of exploded rock, m ³
26.02.95	8160	34	14.4	10	
28.02.95	1831	31	12	8	
24.03.95	3984	27	10	8	15000
28.03.95	3424			10	6000
19.04.95	7942	38	12	10	
20.04.95	5608	31	10.5	12	
25.05.95	3138	55	10	2	
05.06.95	6929	33	12	10	
23.06.95	4301	17	12.5	4	5000
17.07.95	6172	80	10.8	12	
14.08.95	2970	66	10.8	14	2700
26.08.95	1068	22	10.8	6	

Date	Total weight of charge,kg	Amount of holes	Depth of holes, m	Amount of detonators	Volume of exploded rock, m ³
27.09.95	2526	13	12	4	
05.10.95	1278	6	12	6	
12.10.95	2707	13	12	2	
18.10.95	7113	30	12	7	9000
24.10.95	5894	30	12	10	
06.11.95	5442	16	12	5	
23.11.95	2954	15	13.2	6	
19.12.95	7538	38	12	14	
28.12.95	7157	34	13.2	16	
24.01.96	11790	57	12.5	18	23870
13.03.96	14735			32	12675

Date	Total weight of charge,kg	Amount of holes	Depth of holes, m	Amount of detonators	Volume of exploded rock, m ³
05.05.96	9644			10	

In the same time at the new quarry were carried out 17 explosions, information about which was adduted in table 2.

Table 2. Data about chemical explosions, that were carried out during 1995 year and during first half of 1996 year at the new quarry of Novotaubinka.

Date	Total weight of charge,kg	Amount of holes	Depth of holes, m	Amount of detonators	Volume of exploded rock, m ³
26.01.95	4636	198	6.4	12	
16.02.95	3751	22	10.5	6	
22.02.95	986	44	7.2	10	

Date	Total weight of charge, kg	Amount of holes	Depth of holes, m	Amount of detonators	Volume of exploded rock, m ³
26.02.95	4320	180	5.5	10	
23.03.95	5452	230	from 2.5 to 8	12	8700
20.06.95	4159	85	10.8	10	
10.07.95	1910	39	10.8	10	
06.09.95	1914	9	10	6	
10.09.95	1080	34	10.8	6	
16.09.95	3232	34	12	12	
12.10.95	2570	40	12	4	
06.11.95	957	14	12	5	
24.11.95	7626	132	from 9.6 to 10.8	12	
18.12.95	11986	200	11.5	20	21840

Date	Total weight of charge,kg	Amount of holes	Depth of holes, m	Amount of detonators	Volume of exploded rock, m ³
26.01.96	7670	92	11.5	12	15840
06.03.96	9376	104	12	10	31525
20.06.96	10692	116	12	14	

Quarry Sajaevka is situated in 120 km by railway to south-east from Ust-Kamenogorsk city, on the shore of Buhtarma reservoir. At the quarry the works for extracting of limestone for Ust-Kamenogorsk cement factory are carried out. Co-ordinates of quarry - 49°36'20" of north latitude and 83°39'00" of east longitude. During the period under review at the quarry were carried out 11 explosions by the same scheme, how at the old quarry of Novotaubinka, that is in the holes, located quarter net 6x6 m. Information about these explosions, that was given to us by organisation-maker of these works, is shown in table 3.

Table 3. Data about chemical explosions, that were carried out in 1995 and first half of 1996 year at the quarry of Sajaevka.

Date	Total weight of charge, kg	Amount of holes	Depth of holes, m	Amount of detonators	Volume of exploded rock, m ³
25.01.95	29194	100	13.2	20	27525
30.03.95	40883	140	15	28	30000
20.06.95	21318	146	from 13.5 to 14.4	10	21017
28.07.95	19600	70	14	14	
24.08.95	14750	59	12	14	39000
18.09.95	16552	57	12	18	15000
20.09.95	18904	94	10.8	8	25000
01.11.95	44968	146	14.5	38	30000
21.12.95	18668	75	10	18	30000
11.04.96	31248	124	12	28	25000
23.05.96	15048	85	12	18	34000

Quarry Alakol is situated at the prolongation of south-eastern prominence of Alakol lake (Kishi-Alakol bay), near Uzunbulak settlement. At this quarry the works for extracting of coal are carried out. Co-ordinates of this quarry - 45°43'50" of north latitude and 82°10'00" of east longitude. Explosions are carried out in holes, placed upon the rectangular net 2.5 x 3 m. 4 explosions were carried out, information about which was given in table 4.

Table 4. Data about chemical explosions, that were carried out in 1995 and first half of 1996 year at the quarry Alakol.

Date	Total weight of charge,kg	Amount of holes	Depth of holes, m	Amount of detonators	Volume of exploded rock, m ³
13.01.95	7010	200	10	15	
26.01.95	13960	400	9.5	20	
20.02.95	13198	300	10	10	60000
21.05.95	14580	175	13	27	60000

The explosion works were carried out at the road bridge of Shemonaiha city at 28 of March 1995 year, with aim to crush the ice. 30 charges (total power = 1960 kg) of demolition explosives were exploded. Co-ordinates of road bridge of Shemonaiha - 50°37'05" of north latitude and 81°55'00" of east longitude.

All given above information about explosions had been received by us in East-Kazakhstan territory administration of Goverment joint-stock company " Jarilis " in Ust-Kamenogorsk city. Unfortunately, workmakers couldn't give us exact time of making every explosion (that would be very usefull for assured identification of explosions at the seismic records), and informed us only, that in the daily work routine explosions are carried out, as a rule, in interval between 16 and 17 hours of local time.

1.2. Quarries of Southern Kazakhstan.

The quarries, that are situated at the territory of Almaty and Taldykurgan regions, are described in this paragraph.

Quarry Kotur-Bulak is situated in direct closeness to Almaty city. Explosions are carried out here till 1965 year. In last time the frequence of explosions in this quarry consisted examplarily 10 - 12 explosions in year. The weight of charge of ingle explosion consisted 10000-12000 kg. Porphirites of nine group were disclosed by explosions in accordance with building norms and rules (BNaR). In last years at this quarry are carried

not more 3-4 explosions in year with average power 7000 kg.

Quarry of Zholaman plant of rock debris is situated westwards from Sary-Ozek settlement in Malaysary mountains and working from 1966 year. Earlier here 10-12 explosions with summary weight 10000-12000 kg were carried out. At present time the amount of explosions abruptly decrease and consist 4 explosions in year examplarily for 10000 kg every. Porphirites of X group are extracted in accordance with BNaR.

Quarry of Chilbastau plant of road building materials is situated to the north-east from Otar settlement. It is used from 1972 year, limestones of VIII group are disclosed by quarry explosions in accordance with BNaR. Amount of explosions decrease from 10-12 in year (10000-20000 kg everyone) to 1-3 in year (10000 kg).

In 15 km to the north from Kapchagay city the quarry N 12a of Kapchagay plant of building materials is situated. Explosions are carried out here from 1965 year. Earlear 12 explosions in year with weight equal to 5000 kg were carried out here. In last years amount of them decreased to 4-5 in year. Porphyrites of X group are extracted here in accordance with BNaR.

There is Kusak quarry of Karabulak sugar plant in Taldy-Kurgan region. 4 explosions for 5000-7000 kg every are carried out here in one year.

The explosions connected with mining are produced on the mine near Tekely city. These are West, Tekely and Koksu quarries.

There are places, where explosions re carried out during the limit period of time, and they are connected with building or another works. There are single explosions also

are made by different organizations.

In accordance with data that we received, over whelming majority of explosions were produced over observing territory are the single.

The table 5 show the co-ordinates of well-known explosion quarries in Almaty and Taldy-Kurgan regions and adjacent areas of Kazakhstan Republic. The map of quarrie's desposition within the limits of this territory is shown on fig. 1.

Table 5. The coordinates of regions of carrying out of explosions on the territory of Southern Kazakhstan.

N	Name of site (quarry)	North latitude	East longitude
1	Kotur-Bulak	43° 15'	77° 06'
2	Jolaman	44° 15'	77° 35'
3	Chilbastau	43° 42'	75° 20'
4	Quarry 12a	43° 58'	77° 01'
5	Kusakskiyi	44° 50'	78° 24'

N	Name of site (quarry)	North latitude	East longitude
6	Koksu	44° 40'	78° 58'
7	Tekeli	44° 48'	78° 54'
8	Zapadnyi	44° 50'	78° 53'
9	Kalpatasskyi	45° 01'	78° 12'
10	Dalabay	44° 02'	77° 27'
11	Koskuduk	43° 38'	75° 47'
12	Adeksu	43° 50'	74° 44'
13	Aktuz	42° 53'	76° 05'
14	Georgievka	43° 05'	74° 53'

To receive the detailed information about produced explosions from direct makers of explosions not possible in any

time. Organisations-makers are situated in different towns of Republic, and often they stay unknown for seismologists. All, that we could know about quarry and other explosions, that were carried out in 1995 year at the territory of Almaty and Taldy-Kurgan regions is shown in table 6.

Table 6. Data about chemical explosions, that were carried out in 1995 year at the territory of Almaty and Taldy-Kurgan regions.

Date	Name of the site of explosion	Producer	Total weight of charge, kg
24.01.95	Jolaman, the hole Ø250 mm	GJ-SC «Jarilis»	5750
07.02.95	Kotur-Bulak, the hole Ø105 mm	GJ-SC «Jarilis»	5204
21.02.95	Lowering of snow-slip		80
28.02.95	Quarry 12a, the hole Ø125 mm		1135
11.03.95	Jolaman, the holes Ø218 and Ø270 mm	GJ-SC «Jarilis»	14157
21.03.95	Kalpatasskyi, the hole Ø105 mm		30

Date	Name of the site of explosion	Producer	Total weight of charge, kg
28.03.95	Lowering of snow-slip		100
03.04.95	Lowering of snow-slip		100
07.04.95			1749
08.04.95			392
27.04.95	Kusakskyi, the hole Ø105 mm	GJ-SC «Jarilis»	7033
16.05.95	Quarry 12a, the hole Ø125 mm		1241
17.05.95	Jolaman, the hole Ø269 mm	GJ-SC «Jarilis»	12622
01.06.95	Quarry 12a, the hole Ø125 mm		140
07.07.95	Ushalyk, the hole Ø105 mm		5000
10.07.95	Adek-Su, the hole Ø250 mm		2781
11.07.95	Quarry 12a, the hole Ø125 mm		596
14.07.95	Jolaman, the hole	GJ-SC «Jarilis»	11050

	Ø269 mm		
03.08.95	Dalabay		5000
18.08.95	Quarry 12a, the hole Ø125 mm		732
25.08.95	Broadening of the road in Turgen gorge (explosions in the bore-holes Ø42 mm)		360
30.08.95	Kusakskiy, the hole Ø105 mm		6776
06.09.95	Jolaman, the hole Ø250 mm	GJ-SC «Jarilis»	12087.5
10.10.95	Burabayjal station	Deposit of barytes	965
04.11.95	Quarry Kusakskiy	Karabulak sugar plant	8190
24.11.95	Jolaman, the hole Ø250 mm	GJ-SC «Jarilis»	12881
17.12.95	Quarry Kusakskiy	Karabulak sugar plant	6435

1.3. Quarries of Northern Kazakhstan.

In environ of Ekibastuz city 5 coal quarries are situated, and on each of them actually everyday a several number of chemical explosions is carried out. Four quarries - Northern, Eastern, Stepnoy and Bogatyr - directly join to the city from the ast and south-east, and have a sharp of arcs with length till 10 km.

Fifths quarry - Maykubenskyi - is situated in 60 km to the south from the city. On the fig.2 schematic image of location of four suburb quarries concerning each other and elements of country were given. Total number of explosions, that are carried out at the all of quarries - from 10 to 20 in day. During one and half year the total amount of explosions can reach a number of 10 thousand. If we had adduced here such a volume of information, the size of present reports would have gone out of required limits.

Table 7 gives the data about explosions for 1 day - 19 Dec,1995 for example. If the customer have an interest to chemical explosions in Nortern Kazakhstan for concrete segment of time we can to represent all necessary data.

Explosion works at all quarries are carried out in the boreholes by the method of short-slow explosion - for several steps with the interval between step equal to 35 - 50 ms. Table

Table 7. Data about chemical explosions,
that are carried out at the coal
quarries of " Ekibastuzkomir " on
19 Dec, 1995.

Name of quarry	Depth of hole	Amount of stages of delay	Maximum weight of charge for one stage, kg	Total weight of charge, kg
Bogatyr	18	8	684	4788
Bogatyr	24	12	882	10584
Bogatyr	26	3	710	2130
Bogatyr	26	3	936	2808
Severnoyi	21	10	387	3870
Severnoyi	14	5	158	788
Severnoyi	8	6	119	712
Severnoyi	10	6	218	1290
Stepnoy	0 (laid on charges)	7	180	1260

Name of quarry	Depth of hole	Amount of stages of delay	Maximum weight of charge for one stage, kg	Total weight of charge, kg
Stepnoy	18	26	258	6708
Stepnoy	10-18	35	287	10032
Maykubenskyi	12	5	510	2547

At the Eastern quarry in this day the chemical explosions were not carried out. Unfortunately, exact time of carrying out of everyone explosion is not registrated by makers of these works. The explosions are carried out in the second half of work day from 13 to 17 hours of local time.

2. SHORT CHARACTERISTIC OF SEISMICITY OF REGIONS OF LOCATION OF QUARRIES.

The territory of Northern and Eastern Kazakhstan in the whole have not great seismic nature. The region of Ekibastuz, where the chemical explosions are carried out in Northern Kazakhstan is aseismical. Let's observe every local region of Eastern Kazakhstan in concrete.

The quarry of Novotaubinka is situated in a seismic region. During 1995 year and the 1st half of 1996 year on the territory of this region wasn't recorded no one of earthquakes. The region of quarry Sazhaevka is bordering with seismic area called Gorny Altay. During observed period of time 6 earthquakes occurred with magnitude from 3.9 to 5.4 in square with coordinates 47.5-51 of north latitude and 85-91 of east longitude. The nearest to quarry earthquake occurred on 28 of May 1995. The coordinates of epicenter are 47.7 of north latitude and 85.5 of east longitude, magnitude $m = 4.8$, depth of source $h = 24$ km and time in source 21h46m47.7s.

The region of Alakol quarry is situated near areas with high seismicity. To the south-south-east from the quarry during 1995 year 6 earthquakes was recorded with m from 4.05 to 5.6. The epicentres of these events are situated on the territory of China in Sinczian-Uigurski autonomous region (square with coordinates 43-44 of north latitude and 83-85 of east longitude). To the west and south-west from the quarry the seismogenerated zone Dzhungarskaya is placed, with which 2 earthquakes were connected, that happened near from Alakol

quarry on 28 Sep 1995 (44.6 of north latitude and 80.2 of east longitude, $m = 4.8$, $h = 23$ km, time in source 08h32m33.2s) and on 13 May 1996 (45.6 of north latitude, 80.3 of east longitude, $m = 3.5$, $h = 33$ k , time in source 22h28m25.6s).

From seismic point of view Southern Kazakhstan is one of the most seismic regions of Middle Asia and Kazakhstan. For obvious idea about the level of seismic activity of region of location of explosion quarries the map of epicentres of earthquake upon instrumental data for 1961 - 1990 yy. with $K = 9-12$ was drawn (Fig.3). How we can see from this map, in whole the epicentres of the earthquakes are distributed irregularly. Judging from the character of epicentrical field, the main seismic activity is developing at the North-East (Dzhungarskaya zone) and at the South (Tian-Shanskaya zone) of the region, where the high concentration of epicenteres of earthquakes is observed. The rest of part of region is filled by epicentres of earthquakes with different density for different regions. Let's stop more detailly on the features of seismicity in the region of disposition of explosion quarries.

The group of quarries Kusakyskiy, Zapadnaya, Tekeli and Koksuy is related to Dzhungarskaya zone. The maximum accumulation of epicenteres of earthquakes in the region of disposition of quarries exactly is observed. The focuses of these earthquakes connected with South-Dzhungarskaya seismogenerated zone. The seismic hazard of this zone upon the map of seismic division into districts of Kazakhstan (CP-78) is estimated in force 8, and maximum observed earthquake had a magnitude $m = 6.4$.

Quarry Kolpatasskiy, that is situated in the same region, is placed at the western edge of zone Dzhungarskaya and

characterized by relatively low level of seismicity.

The second group of quarries (Dalabay, Zhalaman and 12a) is situated within the limits of epicenter's range, that extend from the west edge of Dzhungarskaya zone to south-west.

The level of seismic activity of this zone relatively low. The magnitude of maximum observed here earthquake don't exceed $m = 6$.

The third group of quarries (Kotur-Bulak, Actuz, Georgievka) was spatially timed to Northern Tyan-Shanskaya seismic zone, that is suffer often and strong earthquakes. Among this group the region of Kotur-Bulak quarry is characterized by the most high level of seismic hazard. It is situated in the focuses of the wellknown force 10 Vernenskyi earthquake in 1887 ($m = 7.3$) and force 10-11 Keminskyi earthquake in 1911 ($m = 8.3$).

The level of modern seismic activity of this region is very high. That is corroborated by data of instrumental seismic observes.

The seismic activity of North-Tyan-Shanskaya zone, extending in sublatitude direction from Dzhambyl city (on the west) to the territory of China (on the east) is not the same at the different places. On the one of the weak seismic places (upon the level of weak earthquake) of this zone the quarry Aktuz is situated though spatially it is timed to the focus of force 10-11 Keminskyi earthquake of 1911 year.

The frequence of repeating of moderate and strong earthquakes is high enough here. The quarry Georgievka is situated within the limits of Chu-Iliyskaya zone, were the modern seismic activity upon the strong earthquakes not high and

activity of weak earthquakes, how we can see from the map, enough appreciable.

The forth group of quarries (Koskuduc, Chilbastau and Adeksu) is situated within the bounds of weak seismic zone, for which the single epicenteres of weak earthquakes are characterized. The main seismic hazard for this group of quarries presents North-Tyan-Shanskaya seismic zone, that situated to the south from it on the distance 80-100 kms.

And, at last, quarry Ushalyk is situated actually in aseismic zone where the level of seismic hazard is connected with transit earthquakes and estimated upon the map of seismic division into districts force 5.

In that way, explosion quarries within the limits of observing region are situated at the different upon degree of seismic hazard places. The regions of quarries, that situated within the limits of North-Tyan-Shanskaya and Dzhungarskaya seismicity zones are known by strong and catastrophical earthquakes in last and active in the present time upon the level both weak and strong earthquakes, and characterized by the great level of seismic hazard.

How we can see from adduced description, in Kazakhstan, particularly in Southern Kazakhstan, there are enough many quarries in the zones of high seismicity. Presence of a rich data base of seismic records of chemical explosions and weak subsurface's earthquakes from one region gives us beatifull possibility for development of methods of determination of chemical explosions and earthquakes.

3. SYSTEM OF OBSERVATION AND APPARACY.

Apparacy, that used in GO " Kurchatov " for record of explosions, accuring at the territory of Northern and Eastern Kazakhstan, was described detaily in report upon Agreement N B301621. So we don't adduce here it's description, we'll only refer one feature, which is considerably influence upon resulation of observations.

Apparacy of system of group " Cross " have a frequence of digitation equal to 40 reading in sec, but it is equiped by band filters in the entrance. Band of passing of filters equal to 0.5-5 Hz (fig.4).

In the same time it is known, that the chemical quarry explosions are more highfrequent (the maximum of energy of P-wave falls on the frequencies about 10 Hz). This is considerably hamper the registration and interpretation of seismic records of explosions.

For determination of explosions it would be more comfortable to use broadband station " DAS " with frequence of digitation equal to 200 readings in second, what allows to registrate actually all the frequente components of the signal from chemical explosion. But for this it is necessary to know the time of conduction of explosions with accuracy till the first seconds, as to determine the coordinates of epicenter with help of three-components records of " DAS " stations with admissible accuracy is dificult.

All the rest part of this chapter we'll devote to the description of system of observation and apparacy of seismic

station of the Institute of Seismology of Ministry of Science of RK and united Institute of Physic of Earth of Russian Academy of Sciences, which was used for registration of chemical explosions at the territory of Southern Kazakhstan (Almaty and Taldy-Kurgan regions).

Special works for recognizing of chemical explosions at the records of seismic stations of the Kazakhstan Republic didn't conducted. Identification of explosions is produced on the base of early installed by empirical way typical features of wave image of records on the determined seismic stations.

For every region of conduction of explosions their own stations were exposed on which such a features reveal more clearly. Figure 1 shows the scheme of distribution of seismic ststions upon records of which pick out the explosions.

The record of seismic events from the explosions is produced by seismic stations with galvanometrical system of record. Seismometricalchannel is consist from seismographs SKM-3 or SM-3, galvanometers GB-4 grouping in block BG-9 with photoregistration on the register RS-PM (fig.5).

These stations are characterised by high sensitivity, broad range of recording frequence, identity of channels and economy.

Complete set such of seismic ststion also consists of the manager desk, the automat of amplification brightness, the magnitoelectrical generator of constant amplitudes (MGCA). All the system of the station works in the united time (GCT).

The registration of seismic events is carried out by three seismometrical channels, that orientate mutually perpendicularly - X, Y, Z. For the record of more strong seismic influences every station has one or three channels with low sensitivity

with coefficient of coarsening equal 20 with respect to main channels. On the all stations the displacement is registering kinematical parameter.

Expereance of many years instrumental observations for the weak earthquakeres and quarry explosions show that at the such of stations installed in good condition (main rocks the level of hindrances), the big extensions can be realize and the ground vibrations can be reproduce with little amplitude of distortions. Amplitude - frequence characteristic such of channel has similar to table look in the range of frequencies about 0.5-10 H. These frequencies correspond to seismic events near weak earthquakeres and industrial explosions.

In the capacity of example values of parameteres of system called seismograph SKM-3 - galvanometer GB-4 that is used on the most of seismicstations of Kazakhstan for channel Z.

Table 8. The values of parameteres of seismometrical channel.

Parameter	Seismograph	Galvanometer
Own frequent f	0.5 Hz	12.3 Hz
The constant of damping D	0.400	8.5

Parameter	Seismograph	Galvanometer
Coefficient of connection of system δ	0.0197	
Increase of channel V	5000-60000	
Range of periods, corresponding to the level of increase $0.9 \cdot V$	0.1-1.6 sec.	

For example we'll show the results of registration by net of stations and the interpretation of records of explosion of quarry that was produced on the 17 of May 1995 year. It was registered by 12 seismic stations of Kazakhstan. One of them - Arharly - with telemetrical transmission of information to the center of interpretation in Almaty city, others - stationary.

Interpretation of records was produced in the same way, how it is doing for the local earthquakes.

Method of summary interpretation is following. The time in the focus was determined from diagramm Vadati. The coordinats of hypocenter ϕ , λ , H were determined from data of times of first wave arrival of P and S waves with useing of velocity model of Shatsilov V.I.[1]. The power class was determined from nomogram of Rautian T.G.[2]. The magnitude of longitudinal wave MRW was determined from regional calibration curve and nomogram of

Mihailova N.N., Neverova N. for Northern Tyan-Shan [3]. Below dynamic and kinematic characteristics of records of this explosion upon the all stations were shown and also the results of summary processing.

Table 9. Example of registration of chemical explosion by the net of seismic stations.
Explosion in the quarry Zholaman. May 17 1995 y., $t = 07h44m55.0s$, $\phi = 44^{\circ}16'$,
 $\lambda = 77^{\circ}37'$, $H = 0-5$ km, $V/V = 1.71$
(Vadati), $K = 7.5$, $MPV = 3.5$.

Seismic station	t min sec	t min sec	t - t	Δ , km	K	MPV
Arharly	ip 44 57.5	is 44 59.5	2.0	15	7.0	-
Chushkaly	ep 45 06.4	is 45 14.8	8.4	65	7.1	3.2
Kuram	ep 45 10.9	is 45 23.4	12.5	98	7.4	3.8
Turgen	ip 45 12.5	is 45 25.3	12.8	106	7.5	3.3
Kurty	ep 45 12.8	is 45 26.3	13.5	108	7.7	3.6
Medeo	ep 45 16.3	es 45 32.0	15.7	128	7.1	3.2

Seismic station	t min sec	t min sec	t - t	Δ , km	K	MPV
Saty	ep 45 19.0	es 45 38.0	19.0	150	7.7	3.4
Tyan-Shan	ep 45 19.5	es 45 38.2	18.7	145	7.6	3.5
Maytiube	ep 45 20.8	es 45 33.9	19.1	155	8.0	3.5
Uzun-Bulak	ip 45 22.1	es 45 42.2	20.1	168	7.6	3.7
Dzharkent	ip 45 23.4	es 45 44.7	21.3	177		3.8
Kastek	ip 45 26.1	is 45 49.1	23.0	187	8.1	3.3

If we'll compare the results of processing of this explosion with real coordinates of Zholaman quarry (table 5), then we can see, that φ , λ , H have a good agreement. The difference in coordinates not more than 2'. Therefore, from the records of available seismic stations it is possible to estimate the parametres of explosions reliably.

4. IDENTIFICATION OF CHEMICAL EXPLOSIONS ON THE SEISMIC RECORDS.

4.1. Lists of explosions, exposed on the seismic records.

4.1.1. Southern Kazakhstan.

The most successful the identification of explosions upon seismic data was carried out on the territory of Southern Kazakhstan. 104 explosions were determined here for 1995 year. The distribution of these explosions upon the power classe K (a) and the time (b) is shown on the figure 7. The power range of recording chemical explosions consists from 4.5 to 9.5.

75 % of all the events connected to range of 6-8 classes. The most strong explosions with $K > 9$ were settled by stations Boralday, Southern, Zhabagly. The most weak explosions were settled by stations Tyan-Shan, Turgen, Chushcaly. Upon the time of 24-hours more than 80 % of all the explosions are produced in work time of day, what clearly shown on the distribution (fig. 7b). This is the interval of time from 4 o'clock till 12 o'clock upon Greenwich. There are a few number of events outside of this interval. Not exclude, that the some of them are weak earthquakes and their connection to explosion are consequence of errors of interpretation.

The table 10 show the list of recorded explosions. It

includes the following data:

- The data of explosion;
- The name of station, from records of which the explosion was indicated;
- t - time of the first wave arrival of P-wave at this station;
- $t - t$ - the time of delay between S- and P-waves;
- K - class of power, determined from nomogram of Rautian T.G. on the base of measures of amplitudes on the records of explosion on this station;
- The name of quarry, with which this explosion was connected;
- total weight of charge (upon the data from the explosion-makers).

The names of stations for short image are:

KST - Kastek, T-Sh - Tyan-Shan, Chshk -Chushkaly, Krt -Kurty, Brd -Boralday, Kpa -Kapal-Arasan, U-B -Uzun-Bulak, Zhbg -Zhabagly, Mdo -Medeo, Uzhn -Uzhnaya, T-K -Taldykorgan, Kur -Kuram, Dzhr - Zharkent.

Table 10. List of explosions, that were registrated from seismic stations of Southern Kazakhstan during 1995 year.

N	DATE	t_p	STATION	$t_s - t_p$	K	NAME OF QUARRY	TOTAL WEIGHT OF CHARGE, kg
1	05.01.95	10 51 51.0	Kst	5.0	7.3	Aktuz	
2	07.01.95	10 09 20.4	Chshk	7.5	6.8		
3	19.01.95	10 06 06.8	Saty	3.5	7.2		
4	19.01.95	12 02 47.5	Kst	3.7	5.7	Aktuz	
5	24.01.95	09 14 51.8	Krt	7.4	6.4	Ushalyk	5.2
6	24.01.95	10 26 15.2	Krt	13.6	6.6	Jolaman	5.7
7	25.01.95	06 17 04.6	Chshk	5.4	5.9		
8	30.01.95	09 13 12.8	U-B	2.5	6.4		
9	07.02.95	08 16 46.6	Mdo	1.4	6.7	Kotur-Bulak	13.1
10	10.02.95	10 13 03.8	Kst	12.0	7.1	Georgievka	
11	21.02.95	05 58 29.3	T-Sh	3.1	5.2	Lowering of	0.08

						snow-slip	
N	DATE	t_p	STATION	$t_s - t_p$	K	NAME OF QUARRY	TOTAL WEIGHT OF CHARGE, kg
12	11.03.95	05 59 05.4	Chshk	1.6	7.0		
13	11.03.95	06 17 24.8	Chshk	8.6	7.3	Zholaman	14.1
14	11.03.95	06 49 52.5	Chshk	1.7	4.8		
15	11.03.95	10 14 15.7	Chshk	1.7	8.0		
16	17.03.95	10 10 56.0	T-K	6.2	7.0	Koksu	
17	17.03.95	13 54 59.3	Krt	5.2	5.6		
18	27.03.95	10 29 42.5	Krt	7.1	8.0		
19	28.03.95	10 27 53.7	T-K	5.5	7.8	Tekeli	
20	28.03.95	12 27 53.5	Trg	3.6	5.6	Lowering of snow-slip	0.1
21	30.03.95	08 44 49.9	Krt	7.1	7.2		

N	DATE	t_p	STATION	$t_s - t_p$	K	NAME OF QUARRY	TOTAL WEIGHT OF CHARGE, kg
22	31.03.95	06 06 30.4	Krt	5.8	5.7	Quarry 12a	
23	03.04.95	09 20 03.1	Trg	3.8	5.0	Lowering of snow-slip	0.1
24	07.04.95	05 20 36.0	Krt	7.4	6.2	out-road excavation	1.7
25	10.04.95	16 39 44.5	T-Sh	3.3	6.0	Lowering of snow-slip	
26	12.04.95	11 41 54.8	U-B	5.2	7.0		
27	12.04.95	11 55 31.8	U-B	3.7	7.4		
28	25.04.95	11 10 48.5	Brd	14.1	7.2		
29	27.04.95	06 16 49.1	Krt	7.4	7.1		
30	27.04.95	09 05 51.7	T-K	3.8	7.0	Kusakskyi	7.0
31	27.04.95	10 50 25.7	Krt	5.7	6.5		
32	30.04.95	10 25 49.0	Kpa	14.3	7.2		

N	DATE	t_p	STATION	$t_s - t_p$	K	NAME OF QUARRY	TOTAL WEIGHT OF CHARGE, kg
33	30.04.95	10 34 19.6	U-B	3.0	5.3		
34	01.05.95	01 49 55.1	Saty	2.5	5.5		
35	03.05.95	10 00 46.0	Zhbg	20.7	7.9		
36	11.05.95	09 01 15.8	Zhbg	22.8	7.6		
37	12.05.95	05 37 15.0	Kst	11.0	6.7	Georgievka	
38	16.05.95	11 41 26.0	Krt	5.6	6.2	Quarry 12a	1.2
39	17.05.95	07 45 10.9	Krt	13.5	7.8	Zholaman	12.6
40	19.05.95	05 16 54.5	Kst	10.9	6.7	Georgievka	
41	24.05.95	10 21 34.0	Kst	5.2	7.0	Aktuz	
42	26.05.95	06 56 04.0	Chshk	1.5	7.0		

N	DATE	t_p	STATION	$t_s - t_p$	K	NAME OF QUARRY	TOTAL WEIGHT OF CHARGE, kg
43	01.06.95	11 07 57.1	Krt	6.1	6.5	Quarry 12a	
44	05.06.95	05 26 54.0	Kst	5.0	6.9	Aktuz	
45	07.06.95	08 39 09.6	Mdo	1.5	7.0	Kotur-Bulak	
46	09.06.95	10 55 09.2	Krt	5.9	6.3	Quarry 12a	
47	16.06.95	08 03 16.1	Kst	11.0	7.0	Georgievka	
48	21.06.95	03 55 26.7	Krt	7.8	7.0		
49	21.06.95	05 35 38.8	Krt	6.9	6.2	Quarry 12a	
50	30.06.95	01 04 49.4	Chshk	2.0	6.7		
51	30.06.95	17 02 50.9	T-Sh	2.7	8.0	Lowering of snow-slip	
52	07.07.95	10 05 32.7	Kst	8.3	6.4	Ushalyk	5.0
53	14.07.95	09 22 27.8	Krt	13.5	7.8	Zholaman	11.05

N	DATE	t_p	STATION	$t_s - t_p$	K	NAME OF QUARRY	TOTAL WEIGHT OF CHARGE, kg
54	17.07.95	10 29 22.4	Krt	18.0	6.8	Georgievka	
55	22.07.95	14 59 22.6	Chshk	3.4	5.8		
56	22.07.95	21 47 51.2	Kst	14.0	7.1		
57	26.07.95	19 59 41.4	Krt	22.6	7.4		
58	28.07.95	10 48 16.2	Uzhn	22.5	8.9		
59	28.07.95	10 59 12.7	Uzhn	21.5	8.1		
60	03.08.95	10 02 45.5	Kst	11.2	6.7	Georgievka	5.0
61	09.08.95	09 54 45.3	Kst	11.0	7.0	Georgievka	
62	28.08.95	05 43 35.2	Krt	7.5	5.8		
63	30.08.95	05 05 52.0	T-K	6.5	7.4	Kusakskyi	6.8

N	DATE	t_p	STATION	$t_s - t_p$	K	NAME OF QUARRY	TOTAL WEIGHT OF CHARGE, kg
64	01.09.95	16 20 56.3	Saty	2.4	5.5		
65	06.09.95	09 44 39.3	Chshk	3.2	6.6		
66	06.09.95	11 39 59.1	Chshk	9.0	7.4	Zholaman	12.1
67	07.09.95	00 37 09.3	Cur	6.0	5.9		
68	07.09.95	09 28 01.7	Kst	11.0	6.9	Georgievka	
69	11.09.95	12 49 26.6	Krt	5.2	6.2		
70	21.09.95	04 53 05.0	Chshk	1.8	7.0		
71	21.09.95	09 44 35.0	Kst	10.7	7.0		
72	02.10.95	11 11 48.7	Brd	7.9	6.5		
73	04.10.95	10 16 13.6	Uzhn	17.0	8.4		
74	07.10.95	10 43 29.5	Brd	13.0	7.3		

N	DATE	t_p	STATION	$t_s - t_p$	K	NAME OF QUARRY	TOTAL WEIGHT OF CHARGE, kg
75	10.10.95	09 51 26.1	Brd	10.6	6.6		
76	10.10.95	10 17 54.4	Uzhn	18.6	8.4		
77	11.10.95	05 07 02.1	Chshk	1.7	5.2		
78	21.10.95	07 11 40.7	Kst	11.6	6.6	Georgievka	
79	02.11.95	02 49 20.5	T-K	4.8	4.7	Kusakskyi	
80	02.11.95	10 47 44.8	Uzhn	21.1	8.4		
81	03.11.95	02 24 27.5	Kst	6.3	7.1		
82	04.11.95	06 24 44.8	T-K	6.3	8.2	Kusakskyi	8.2
83	04.11.95	09 28 51.0	Saty	16.0	6.9		
84	04.11.95	15 03 56.8	U-B	13.5	6.8		

N	DATE	t _p	STATION	t _s - t _p	K	NAME OF QUARRY	TOTAL WEIGHT OF CHARGE, kg
85	06.11.95	10 51 11.4	Brd	14.2	6.9		
86	08.11.95	10 29 59.6	Uzhn	20.2	7.7		
87	10.11.95	04 38 51.9	Kpa	8.5	7.1		
88	10.11.95	10 56 20.5	Brd	11.4	7.6		
89	10.11.95	11 09 07.7	Uzhn	18.5	7.4		
90	13.11.95	07 23 22.1	Krt	18.9	7.1		
91	15.11.95	02 59 51.7	Dzhr	6.5	5.8		
92	16.11.95	10 40 56.9	Uzhn	11.3	8.5		
93	20.11.95	00 07 16.3	Dzhr	10.9	7.1		
94	23.11.95	10 52 29.8	Uzhn	21.0	9.5		
95	24.11.95	10 21 34.0	Chshk	9.5	7.7	Zholaman	12.9

N	DATE	t_p	STATION	$t_s - t_p$	K	NAME OF QUARRY	TOTAL WEIGHT OF CHARGE, kg
96	27.11.95	11 09 10.0	Krt	17.5	6.7		
97	06.12.95	06 24 14.5	Kst	11.2	6.6	Georgievka	
98	12.12.95	09 06 16.4	Uzhn	20.9	8.6		
99	14.12.95	06 03 41.9	Mdo	2.1	7.1	Kotur-Bulak	
100	15.12.95	07 02 40.1	Dzhr	12.0	8.5		
101	15.12.95	08 58 25.2	Uzhn	17.5	7.8		
102	15.12.95	09 41 31.8	Uzhn	23.5	9.4		
103	17.12.95	08 40 17.3	T-K	4.0	7.4	Kusakskiy	6.4
104	26.12.95	06 48 22.4	Kst	5.0	6.3	Aktuz	

4.1.2. Eastern Kazakhstan.

For the registration of chemical explosions on the territory of Eastern Kazakhstan (so as Northern) the system of grouping " Cross " was used, which has, how indicated above, not enough broadband of permission of entrance filters, what maked the registration and identification of explosions difficult of acces.

The chemical explosions on the territory of Northern Kazakhstan are recorded relatively not bad, but the explosions at Eastern Kazakhstan practically aren't separable from noise in most causes. Probably, beside of cutting off of high frequencies of signal by band filters SG " Cross ", the registration is made difficult to acces by unfavourable configuration of explosions. If the slowing down during explosion consists 35-30 ms on the one step in the Northern Kazakhstan, this mesure in the Eastern Kazakhstan is considerably more (however exact mesure was not reported by maker of explosions).

Table 11. List of events, registrated by system
of grouping called " Cross " and
identificated like chemical explosions on
the territory of Eastern Kazakhstan.

Upon the data of explosion-makers in Novotaubinka for 19.12.95, explosion was produced with total power equal to 7531 kg. In Sazhaevka (01.11.95) explosion was produced with 44968 kg of explosive. Table include events, which occurred not only on the quarries, described above, but and on the other regions of Eastern Kazakhstan, and also on the adjacent territories (Altay, Kuzbuss, Hakaziya, Balhash).

4.1.3. Northern Kazakhstan.

How it was indicated above, our information upon this territory in the present account was represented only by illustration. In the table 12 for example shown the data of several explosions, which were produced in the quarries of Ekibastuz. In the whole at the present day Northern Kazakhstan - the huge reserve for continuation of works for creation of data base upon the chemical quarry explosions.

The comparison of coordinates of quarries and calculated epicenters of explosions as the comparison of real and calculated coordinates of quarries in the Eastern Kazakhstan testifies, that the epicenters of seismic events are determinate until with low degrees of truth. So proceeding from the location of Ekibastuz quarry, the difference between the coordinates of explosions upon the latitude mustn't to exceed 42', and upon the instrumental calculations this difference reaches 1.79. The necessity of calibration of seismic station and improving algorithms of localization of seismic events absolutely clear follows from this.

Table 12. List of events, that were registrated
by system of grouping, called " Cross ",
and were identifikated as chemical
explosions on the coal quarries of
Ekibastuz.

Date	Azimuth of wave's arrival	Azimuthal velocity, km/s	Calculated coordinates of source, °		Time in the source
			latitude	longitude	
01.11.95	311.2	5.93	51.64	75.6	08:51:48.0
19.12.95	302.65	6.06	52.07	75.6	07:21:08.5
19.12.95	302.22	6.06	52.22	76.2	07:59:04.3
19.12.95	294.2	7.25	50.68	75.67	08:12:14.0
19.12.95	300.83	5.96	51.45	75.8	08:35:42.0
19.12.95	290.0	6.1	51.36	75.15	08:47:45.5
19.12.95	301.2	6.2	50.73	75.37	08:50:03.3
19.12.95	291.73	6.0	51.39	75.25	09:07:50.5

Date	Azimuth of wave's arrival	Azimuthal velocity, km/s	Calculated coordinates of source, ° latitude longitude		Time in the source
11.04.96	301.78	5.98	52.03	76.06	09:00:21.3
11.04.96	301.4	6.06	51.13	74.86	09:06:05.3
11.04.96	291.2		51.22	75.96	09:11:23.2
11.04.96	304.9	6.2	50.43	76.39	09:26:00.7
11.04.96	299.9	5.94	51.67	75.18	09:40:35.0
11.04.96	302.26		51.48	76.3	10:03:05.6

4.2. Correlations between the power class and summary weight of charge.

From data about the summary weight of charge (Q) and power class K of explosions, that we possess, the correlations $K = K(Q)$ were studied. Firstly, such a correlation was researched upon the all of materials about explosions at the Northern Tyan-Shan. Data about explosions in the region Medeo in 1966 and 1972-1975 yy., that were produced for building of protection

dam, were used. There were data upon 95 explosions. The data upon explosions of quarry of Kotur-Bulak (total amount of explosions - 20) for period since 1972 till 1974 years are present also. For period since 1973 till 1974 the data upon the building explosions from the region Kapchagay (total amount of explosions - 5) are present. Besides this, for period since 1993 till 1994 yy. the data about explosions on the three near situated quarries, that are placed near Taldykorgan city, are present. These are the Zapadnyi, Tekely and Koksus quarries.

In the second, $K = K(Q)$ were learned separately upon the results of registration of chemical explosions on the territory of South Kazakhstan during 1995 year. In all the information about the value Q only 19 explosions are present. On the figure 8 the diagram of dependence K and Q from all of the data about explosions at the Northern Tyan-Shan are shown. Equation of regression have an image:

$$K = 1.52 \cdot \lg Q(\text{kg}) + 1.64$$

Accuracy of estimations from solved equation of regression equal to 1 unit upon K . Figure 8 show, that the data upon the separate quarries from specific features group by certain manner and the own dependences $K = K(Q)$ can be found for them. So, the points, that characterize explosions at the quarry Kotur-Bulak are situated in the main above the regress line that was drawn upon all of the data. Points upon the iron explosions in the Taldykorgan region are enough well connected by found

dependence.

The same figure show the line of regression, founded upon the limited data of Aptikaev F.F. (1969). Taking into account the new data upon the Northern Tyan-Shan, we can say, that this dependence unsatisfactorily describe them, so as the ost of points for explosions with $K = 5-9$ are situated below of the line of regression.

The data for 1995 year are separately adduced on the fig. 9. The same figure show the line of regression, according to all of the present data. Within the limits of this range according to

$$K = 1.52 \cdot \lg Q(\text{kg}) + 1.64 (\pm 1)$$

about 90% of experience points are situated.

4.3. Examples of records of explosions.

4.3.1. Southern Kazakhstan.

Southern Kazakhstan is distinguished by rich set of records of events, that are identifiicated like chemical explosions. The principle of selection of examples for present report was following:

1. One event was recorded by several stations;
2. One station made the records of explosions from

different quarries. Besides, for one and the same quarry examples of different explosions were shown. 20 records of explosions from 7 explosion areas from 12 explosions were presented in total. Examples of records of explosions in Kotur-Bulak from February 7 and June 7 were shown upon 4 and 3 stations accordingly, explosions in Jolaman and Georgivka - upon 2 stations.

The list of presented copies of records is adduced in table 13.

The distribution of channels of records for all stations is unified. The vertical channel Z is the lowest at the seismogramm. Then the channel E-W is following, then N-S. The fourth channel at the several stations is the channel of low sensitivity (CLS). The parameters of apparacy for concrete stations are shown in table 14.

Table 13. List of copies of explosions in
Southern Kazakhstan.

DATA	TIME	STATION	NUMBER OF FIGURE	QUARRY, REGION
5.01.95	1051	Kastek	10	Aktiuz
7.02.95	0816	Talgar	11	Kotur-Bulak
		Tian-Shan	12	
		Almaty	13	

		Medeu	14	
10.02.95	1013	Kastek	15	Georgievka
		Kurty	16	
28.03.95	1027	Taldykorgan	17	Tekeli
17.05.95	0745	Kurty	18	Jolaman
		Kastek	19	
24.05.95	1021	Kastek	20	Aktiuz
07.06.95	0839	Almaty	21	Kotur-Bulak
		Tian-Shan	22	
		Medeu	23	
16.06.95	0803	Kastek	24	Georgievka
14.07.95	0922	Kastek	25	Jolaman

		Kurty	26	
10.10.95	1017	Jujnaya	27	didn't determine
15.12.95	0702	Jujnaya	28	didn't determine
17.12.95	0840	Taldykorgan	29	Kuksaksky

Table 14. Parametres of apparacy of seismic stations, the copies of records of which were used in report for example.

STATION	SENSOR	V_m	T_m, s	CHANNELS
Jujnaya	SKM	10000	0.1 - 1.4	Z,N-S,E-W
Taldykorgan	SKM	10380	0.15 - 1.45	N-S
		518	0.15 - 1.45	
Kastek	SKM	40500	0.1 - 1.5	Z, N-S, E-W
		2030	0.1 - 1.5	E-W
Kurty	SKM	40150	0.1 - 1.4	Z,N-S,E-W

Medeu	SKM	40150	0.1 - 1.4	Z,N-S,E-W
Tian-Shan	SKM	40100	0.1 - 1.5	Z,N-S,E-W
Almaty	SKM	5000	0.1 - 1.3	Z,N-S,E-W
		250	0.1 - 1.3	Z,N-S,E-W
Talgar	SM-2	60000	0.1 - 1.4	Z,N-S,E-W

4.3.2. Eastern Kazakhstan.

17 examples of records from 9 events, that took a place at the 8 areas - Novotaubinka, Sajaevka, Semipalatinsk city, Achinsk city, Abakan city, Kounradskii settlement, Sayak settlement, Ust-Koksa settlement are shown on fig. 30-46. The areas with epicenters of last 6 events are not the quarries of Government joint-stock company " Jarilis ", and events, that were recorded on them, can be both the explosions, that were carried out by unknown organisations, and weak earthquakes.

The records are presented in following two variants:

1. Seismogramms of all sensors of " Cross ", that were in order at the moment of registration (the total number of sensors is 21, but not the all sensors are working good, for

example, 03.05.1995 all the 21 sensors made a record qualitatively, but 11.04.1996 - only 13). From these records the azimuth of signal arrival and azimuthal velocity are determined very well.

2. The seismograms of border northern, southern, eastern and western sensors of " Cross ", that were in good condition. On these records we can see the detail wave picture of event on a large vertical scales.

4.3.3. Northern Kazakhstan.

On the fig. 47-68 shown 22 examples of records from 14 explosions in the region of Ekibastuz.

CONCLUSION

The data about industrial explosions, that were produced in 1995 and first half of 1996 year in Southern, Eastern and Northern Kazakhstan, are presented here.

Created data base can be used for solving of following tasks:

1. Upon the data base of explosions and earthquakes from one region to continue improving of methods of reckognizing of explosions and earthquakes.

2. To use the records of industrial explosions for calibration of seismic stations (Borovoe, Kurchatov, Makanchi) and for improving of algorithms of localization of epicenteres. With the similar aims we can conclude a contract with explosion-makers, in Ekibastuz for example, upon which the seismologists will receive the data about exact time of production, exact coordinates, power and configuration of explosions.

It is necessary to note, that represented data base doesn't claim on the plentitude, and it can be increased greatly. We have following opportunity for this:

1. The volume of data base can be essentially increased at the expence of including of total information about chemical explosions at the coal quarries of Ekibastuz.

2. It is possible to increase the amount of contacts with organizations-makers of explosions, both at the old and at the new territories - in Western Kazakhstan, for example.

3. Information for more broad interval of time can be

included in data base.

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Figure 1.

EKIBASTUZ COAL BASSIN

The plan

Coordinates of the points shown on the plan as number

№№	Latitude	Longitude	№№	Latitude	Longitude
1	51°44'50"	75°21'30"	5	51°41'05"	75°28'10"
2	51°39'35"	75°23'00"	6	51°38'00"	75°25'30"
3	51°44'10"	75°22'30"	7	51°41'10"	75°27'20"
4	51°40'40"	75°27'20"	8	51°39'15"	75°24'45"

Figure 2.

Figure 3.

амплитудно-частотная характеристика датчиков СГ "Крест"

Figure 4.

Figure 5.

Figure 6.

Figure 7.

Q, kg

Figure 8.

$Q, \text{ kg}$

Figure 9.

10.00
10

05. 01. 95. $t = 10^h 51^m$ SKM $V = 40\ 000$
st. Kastek quarry Aktyuz

Figure 10.

07. 02. 95. t=08^h16^m SKM V=60 000
 st. Talgar quarry kotuzbulak

07.02.95. 13:00m
 st. Talgar
 quarry
 hΔt = +0.7° (12-13°)

Figure 11.

is 08-16-54.1

07. 02. 95. t=08^h16^m SKM V=40000
st.Tien-Shan quarry Kotuzbulak

ip 08-16-49.1

Figure 12.

07.02.95. t=08^h-16^m SKM V=5000
st. Almaty quarry kotubulak

ES 08-16-518

CP 08-16-480

Figure 13.

07.02.95. $t = 08^h 16^m$ SKM $V = 40000$
st. Medeu quarry Kotuzbulak

08-16-45.6

10. 02. 95. $t=10^h-13^m$ SKM $V=40\ 000$
st. Kastek quarry Georgiyevka
1 Oct. 16^h 05^m 10. 02. 95.

Figure 15. 23

10. 02. 95. $t = 10^h - 13^m$ SKM V=40000
st. Kuzty quarry Georgiyevka

10.02.95

10.13.13.5

ip 10-13-13.5

10.02.95

28.03.95. $t=10^h-27^m$ SKM $V=10000$
st. Taldy Kozgan quarry Tekeli

ep 10-27-53.7

17. 05. 95. $t = 07^h - 45^m$ 8KM $V = 40000$
st. Kuzty quarry Dzolaman

07-45-26.0

07-45-12.6

17. 05. 95. $t = 07^h 45^m$ SKM V=40000
st. Kastek quarry Dzolaman

Figure 19.

24.05.95 $t=10^h 21^m$ SKM $V=40000$
st. Kaster *св. Актыуз*

Figure 20.

ip 10-21-23

07. 06. 95. $t = 08^h - 39^m$ SKM $V = 5000$
st. Almaty quarry Koturbulak

ip 08-39-11

h m s
15 08 39 19.0

07. 06. 95. $t = 08^h - 39^m$ SKM $V = 40000$
st. Tien-Shan quarry Koturbulak

LP 08-39-12.9

Figure 22.

07. 06. 95. $t=08^h-39^m$ SKM $V=40000$
 st. Medeu *quarry* Kotuzbulak

Figure 23.

16.06.95.
st. Kastek

t=08^h-03^m
quarry

SKM V=40000
Georgiyevka

Figure 24.

14. 07. 95. t=09^h-22^m SKM V=40000
st. Kástek quarry Džolaman

Figure 25.

Figure 26.

10. 10. 95. $t=10^h-17^m$ SKM $V=10\ 000$
st. Yuzhnaya quarry is not found

es 10-18-13,0

ep 10-17-54,4

15.12.95. t=09^h-41^m SKM V=10000
st Yuzhnaya quarry is not found.

Figure 28.

17. 12. 95. $t = 08^h - 40^m$ SKM. $V = 10000$
 st. Taldy Kozgan *quarry* Kusakskiy

Figure 29.

Filter: None, Amp: Auto

JSPC dbpick: C95123 nt123.ps vadim Wed Oct 2 02:06:20 1996

Figure 30.

Filter: None, Amp: Auto
 JSPC dbpick: C95123 nt123s.ps vadim Wed Oct 2 02:10:29 1996

Figure 31.

Figure 32.

Filter: 1.0-2.0 BP, Amp: Auto

JSPC dbpick: C95305 s305s.ps vadim Tue Oct 1 04:06:42 1996

Filter: 1.0-2.0 BP, Amp: Auto

JSPC dbpick: C95353 nt353.ps vadim Thu Oct 3 05:15:58 1996

Figure 33.

Filter: 1.0-5.0 BP, Amp: Auto

JSPC dbpick: C95353 nt353s.ps vadim Thu Oct 3 05:21:27 1996

Figure 34.

Filter: 1.0-5.0 BP, Amp: Auto

JSPC dbpick: C95353 kb353_1.ps vadim Sun Oct 6 03:59:10 1996

Figure 35.

Filter: 1.0-5.0 BP, Amp: Auto
JSPC dbpick: C95353 kb353_1s vadim Sun Oct 6 05:26:37 1996

Figure 36.

Filter: 1.0-5.0 BP, Amp: Auto
 JSPC dbpick: C95353 kb353_2.ps vadim Sun Oct 6 05:46:54 1996

Figure 37.

Figure 38.

Filter: 1.0-5.0 BP, Amp: Auto

JSPC dbpick: C95353 kb353_2s.ps vadim Sun Oct 6 05:45:40 1996

Figure 39.

Filter: 1.0-5.0 BP, Amp: Auto

JSPC dbpick: C95353 bl353_2 vadim Sun Oct 6 04:33:55 1996

Filter: 1.0-5.0 BP, Amp: Auto
JSPC dbpick: C95353 bl353_2s.ps vadim Sun Oct 6 04:34:44 1996

Figure 40.

Filter: 1.0-5.0 BP, Amp: Auto

JSPC dbpick: C95353 bl353_1.ps vadim Sun Oct 6 02:48:35 1996

Figure 41.

Filter: 1.0-5.0 BP, Amp: Auto
JSPC dbpick: C95353 bl353_1s.ps vadim Sun Oct 6 02:49:27 1996

Figure 42.

Filter: 1.0-2.0 BP, Amp: Auto
JSPC dbpick: C96102 bl102_1.ps vadim Wed Oct 2 08:53:27 1996

Figure 43.

Filter: 1.0-2.0 BP, Amp: Auto

JSPC dbpick: C96102 bl102_1s.ps vadim Wed Oct 2 08:54:25 1996

Figure 44.

Figure 45.

Filter: 1.0-5.0 BP, Amp: Auto

JSPC dbpick: C96103 eq103.ps vadim Sun Oct 6 07:57:51 1996

Filter: 1.0-5.0 BP, Amp: Auto
JSPC dbpick: C96103 eq103s.ps vadim Sun Oct 6 07:58:53 1996

Figure 46.

Filter: 1.0-2.0 BP, Amp: Auto

JSPC dbpick: C95305 e305_1.ps vadim Tue Oct 1 02:49:47 1996

Figure 47.

Filter: 1.0-5.0 BP, Amp: Auto

JSPC dbpick: C95305 e305_s.ps vadim Tue Oct 1 04:03:12 1996

Figure 48.

Figure 49.

Filter: 1.0-5.0 BP, Amp: Auto

JSPC dbpick: C95353 e353_1.ps vadim Thu Oct 3 09:33:36 1996

Figure 50.

Filter: 1.0-5.0 BP, Amp: Auto

JSPC dbpick: C95353 e353_1s.ps vadim Thu Oct 3 09:34:25 1996

Figure 51.

Filter: 1.0-5.0 BP, Amp: Auto

JSPC dbpick: C95353 e353_2.ps vadim Thu Oct 3 09:57:08 1996

Filter: 1.0-5.0 BP, Amp: Auto

JSPC dbpick: C95353 e353_2s.ps vadim Thu Oct 3 09:57:54 1996

Figure 52.

Filter: 1.0-5.0 BP, Amp: Auto

JSPC dbpick: C95353 e353_3.ps vadim Thu Oct 3 10:12:44 1996

Figure 53.

Filter: 1.0-5.0 BP, Amp: Auto

JSPC dbpick: C95353 e353_3s.ps vadim Thu Oct 3 10:13:53 1996

Figure 54.

Figure 55.

Filter: 1.0-5.0 BP, Amp: Auto

JSPC dbpick: C95353 e353_4.ps vadim Sun Oct 6 01:48:17 1996

Filter: 1.0-5.0 BP, Amp: Auto

JSPC dbpick: C95353 e353_4s.ps vadim Sun Oct 6 01:50:20 1996

Figure 56.

Filter: 1.0-5.0 BP, Amp: Auto

JSPC dbpick: C95353 e353_7s.ps vadim Sun Oct 6 05:21:16 1996

Figure 57.

Figure 58.

Filter: 1.0-5.0 BP, Amp: Auto

JSPC dbpick: C95353 e353_5.ps vadim Sun Oct 6 02:02:46 1996

Figure 59.

Filter: 1.0-5.0 BP, Amp: Auto

JSPC dbpick: C95353 e353_5s.ps vadim Sun Oct 6 02:03:50 1996

Figure 60.

Filter: 1.0-5.0 BP, Amp: Auto

JSPC dbpick: C95353 e353_6.ps vadim Sun Oct 6 05:43:56 1996

Filter: 1.0-5.0 BP, Amp: Auto

JSPC dbpick: C95353 e353_6s.ps vadim Sun Oct 6 05:44:34 1996

Figure 61.

Figure 62.

Filter: 1.0-2.0 BP, Amp: Auto

JSPC dbpick: C96102 e102_1.ps vadim Wed Oct 2 05:35:31 1996

Figure 63.

Filter: 1.0-2.0 BP, Amp: Auto

JSPC dbpick: C96102 e102_1s.ps vadim Wed Oct 2 05:36:25 1996

Figure 64.

Filter: 1.0-2.0 BP, Amp: Auto

JSPC dbpick: C96073 ekibas1.ps vadim Thu Sep 12 04:41:48 1996

Figure 65.

Filter: 1.0-5.0-BP, Amp: Auto

JSPC dbpick: C96073 ekibas2.ps vadm Thu Sep 12 05:05:43 1996

Figure 66.

Filter: 1.0-5.0 BP, Amp: Auto

JSPC dbpick: C96073 ekibas3.ps vadim Thu Sep 12 05:06:25 1996

Figure 67.

Filter: 1.0-5.0 BP, Amp: Auto
JSPC dbpick: C96073 sob1.ps vadim Thu Sep 12 09:15:23 1996

Figure 68.

Filter: 1.0-5.0 BP, Amp: Auto

JSPC dbpick: C96073 sob2.ps vadim Thu Sep 12 09:16:17 1996

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