MDCB 地震预测系统使用的 MDCB-5/ MDCB-6 型临震信息监测仪介绍
Introduction of the MDCB-5/MDCB-6 Earthquake Electromagnetic Precursor Monitoring Instrument for the MDCB Earthquake Prediction System

推荐方： 全国 MDCB 电磁波地震监测协作网
Recommended by: The MDCB Earthquake Prediction Network

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译者注：这是该 MDCB 仪器介绍的英译文初稿，在译文中可能包括某些不当之处。非常欢迎指出这样不当之处和／建议的读者告之译者：陈一文〔中国地球物理学会天灾预测专业委员会顾问〕。

Translator's Note: This is the 1st English translation draft of this introduction of the MDCB instrument, which might contain various errors in the translation. Readers who identify such errors and/or have questions/suggestions are most welcomed to inform the translator: Chen I-wan, Advisor, Committee of Natural Hazard Prediction for China Geophysics Society: cheniwan@263.net

1. MDCB 预报地震系统：五个组成部分

1. The MDCB Earthquake Prediction System: Consisted of Five Portions.

MDCB 预报地震系统由五部分组成：〔1〕三种型号的地震监测仪器〔DYL 型、MDCB-5 型与 MDCB-6 型〕；〔2〕相应的数据采集程序；〔3〕数据处理程序；〔4〕数据分析方法；〔5〕相应的软件程序。

The MDCB Earthquake Prediction System is formed by five (5) portions: (1) Three (3) types of earthquake (EQ) monitoring instruments (the DYL, MDCB-5 and MDCB-6 models); (2) Related data collection programs; (3) Data processing programs, (4) Data analysis methods, and (5) Related software programs.

MDCB 的含义为“煤—电磁波”〔Mei-Dian-Ci-Bo〕。

The meaning of MDCB is “Coal Electro-magnetic Wave” (Mei-Dian-Ci-Bo).

2. MDCB 型仪器的工作原理

2. The working principle of the MDCB instruments

DYL 型地应力监测仪监测震源区由于地应力发生变化导致该深度地质体对天然电磁波反射系数发生变化，从而使仪器接收的电磁波信息转化的电压值发生变化，一般电压值较高的地区是未来发震的震源区（地热异常区除外），据此判断震源区所在位置。

When there is variation in the terrestrial stress level in the focal area monitored by the DYL Terrestrial Stress Monitoring Instrument, it causes variation of the reflection factor by such geological body at deep depths to natural electromagnetic (EM) waves, which results in variations of the voltage value converted by such EM waves monitored by the DYL instrument. The areas showing high voltage values normally correspond to focal areas where future EQs will occur (with the exception of geothermal abnormality areas), based on which the location of focal areas can be determined.

MDCB-5 型仪器监测地震前震源区内产生的电磁波沿着岩石破裂面方向传播的电磁波；

The MDCB-5 instrument monitors the EM waves generated within focal areas transmitting along the direction of the fracturing plain of the rock body before the occurrence of earthquakes.

MDCB-6 型仪器监测地震前震源区内产生的电磁波呈漫反射形式向四外传播的电磁波；

The MDCB-6 instrument monitors the EM waves generated within focal areas transmitting in all directions as diffusion reflection from the focal area before the occurrence of earthquakes.

3. MDCB 法预报地震系统硬件

3. The MDCB EQ Prediction System - Hardware

3.1 DYL 型地应力探测仪

3.1 The DYL Terrestrial Stress Measurement Survey System

主要是对可能的地震危险区和其外围地区地下 5 Km、7 Km、10 Km 三个深度地应力普查，确定工作区内是否潜伏着破坏性地震的应力场、具体位置。

Mainly used for terrestrial stress general survey at 3 depths -5 km, -7 km, -10 km over possible EQ risk areas and their surrounding areas, to determine if hidden stress fields at which damaging EQs might occur in the future within the targeted surveyed area, and their specific locations.

3.2 MDCB-5 型地震前兆监测仪（分 MDCB-5-1、-2 两种）

3.2 The MDCB-5 EQ Precursor Monitoring Instrument (two types: MDCB-5-1 and MDCB-5-2)

中心台站与区域分台站主要使用该仪器。其中 MDCB-5-1（8 方位）仪器的传感器和地面成 45°角，按 E、NE、N、NW、W、SW、S、SE8 个方向分布，分别监测台站周围各方向上的震源区每天活动的次数，根据异常活动的幅度和次数判断台站周围哪个方向在最近 7 天之内可能发生几级地震；MDCB-5-2（32 方位）仪器同上，不同点：传感器按 11.25°角分布，确定方位角精度高。

The central stations and regional sub-stations mainly use this model of instruments. MDCB-5-1 has 8 sensors arranged at an inclined angle of 45° towards ground level at 8 directions, i.e. E, NE, N, NW, W, SW, S, SE respectively, each monitoring the number of times of activities of each focal area around the monitoring station in each of these directions, and according to the amplitude and numbers of the activities, determine in which direction what magnitude of EQ might occur during the next 7 days. The MDCB-5-2 is similar to MDCB-5-1, but, instead of 8 sensors in 8 directions, the MDCB-5-2 has 32 sensors in 32 directions, i.e. 11.25° angle apart each other, thus with much higher accuracy in determining the azimuth angle of the focal areas.

3.3 MDCB-6 型地震前兆监测仪

3.3 The MDCB-6 EQ Precursor Monitoring Instrument

在地震危险区周围的台站（俗称近区分台站）一般使用该仪器。这种台站的仪器一般距地震危险区 150 公里以内，仪器的传感器定向、定深度监测潜伏的震源区不同深度与部位电磁波的变化，根据该震源区异常变化的周期和幅度，结合远区分台站提供的临震信息确定未来发震时间和震级大小。

The monitoring stations close the focal areas, usually called the nearby-area sub-stations, normally use this type of instrument. These instruments generally are located within 150km from the EQ risk zones. The sensors of the instrument are adjustable, adjusted at inclination angles and directions to monitor the variation of EM waves generated from specific locations and depths of the focal area. The occurrence time and magnitude level of the future EQs are determined by the cycles and amplitudes of the daily anomaly variation of the respective focal area, together by analyzing the EQ precursor information monitored by the remote stations located in remote areas.

MDCB-6 型地震前兆监测仪也可以用来对滑坡危险山体的远距离监测。

MDCB-6 instrument can also be used to monitor, at remote distance, mountain bodies with landslide risk.

4. MDCB 预报地震系统软件

4. The MDCB EQ Prediction System - Software

4.1 DYL 地应力探测仪 – 软件

4.1 The DYL Terrestrial Stress Measurement Survey Instrument - Software

数据采集程序；数据处理程序。

Data collection program; data processing program.

4.2 MDCB-5 型临震信息监测仪（分 MDCB-5-1、-2 两种）- 软件

4.2 The MDCB-5 EQ Precursor Monitoring Instrument (two types: MDCB-5-1 and MDCB-5-2) - Software

MDCB-5-1、-2 数据采集程序；MDCB-5-1、2 数据处理程序。两种型号的仪器采样间隔都是 20 秒采集一次，由于传感器的数量不同，采集的数据量和存储格式也不一样，也就是说采集、处理的程序不相同，但处理的结果一样，都是 16 张图和 10 种数据表。

The MDCB-5-1, -5-2 data collection program; and the MDCB-5-1, -5-2 data processing program. The data collection interval of both models is 20 seconds. As the number of sensors of model MDCB-5-1, -5-2 is different, the amount of data collected and the format of storage is different, i.e. the data collection programs and data processing programs for both these models are different, but the result of data processing is the same, i.e. 16 graphs and 10 data tables, as explained in detail later.

4.3 MDCB-6 型地震前兆监测仪 – 软件

4.3 The MDCB-6 type EQ Precursor Monitoring Instrument - Software

MDCB-6 数据采集程序；MDCB-6 数据处理程序；6 型仪器对数据处理的图形有 9 种图形和 4 种数据表。根据这些图形和数据的变化研究震源区每天的变化，结合外围台站的临震信息适时做出发震时间的判断。

The MDCB-6 data collection program; and the MDCB-6 data processing program. The graphs processed by the data monitored by MDCB-6 include 9 graphs and 4 data tables. The occurrence time of the future EQs are determined by the cycles and amplitudes of the daily anomaly variation of the respective focal area, together by analyzing the EQ precursor information monitored by the remote stations located in remote areas.

4.4 震情研究辅助的软件程序

4.4 Software programs aiding seismic situation analysis

程序 1：查找上一天世界上发生 Ms5.0 以上、国内 Ms4.0 以上的地震位于观测台站方位角程序；

Program 1: Check and calculate the azimuth angles respective to the monitoring station of all EQs occurred in the world ≥Ms5.0 and all EQs occurred in China ≥Ms4.0.

程序 2： 查找与某个台站匹配的其它台站将要发生地震的方位角程序；

Program 2: Check and calculate the azimuth angles of a monitoring station corresponding to the azimuth angle of other monitoring stations in which direction EQs will occur.

程序 3： 利用交汇程序输入各台站发震方位角交汇未来震中；

Program 3: Use the Intersection Program to intersect the locations of future EQs by inputing the azimuth angles of each monitoring station in which direction

EQs will occur.

程序 4： 用震级计算程序计算确定的各个发震地点的震级；

Program 4: Use magnitude calculation program to calculate and determine the magnitude of each epicenter area predicted EQs would occur.

5. 仪器技术参数与外观相片

5. Technical specifications and photos of the instruments

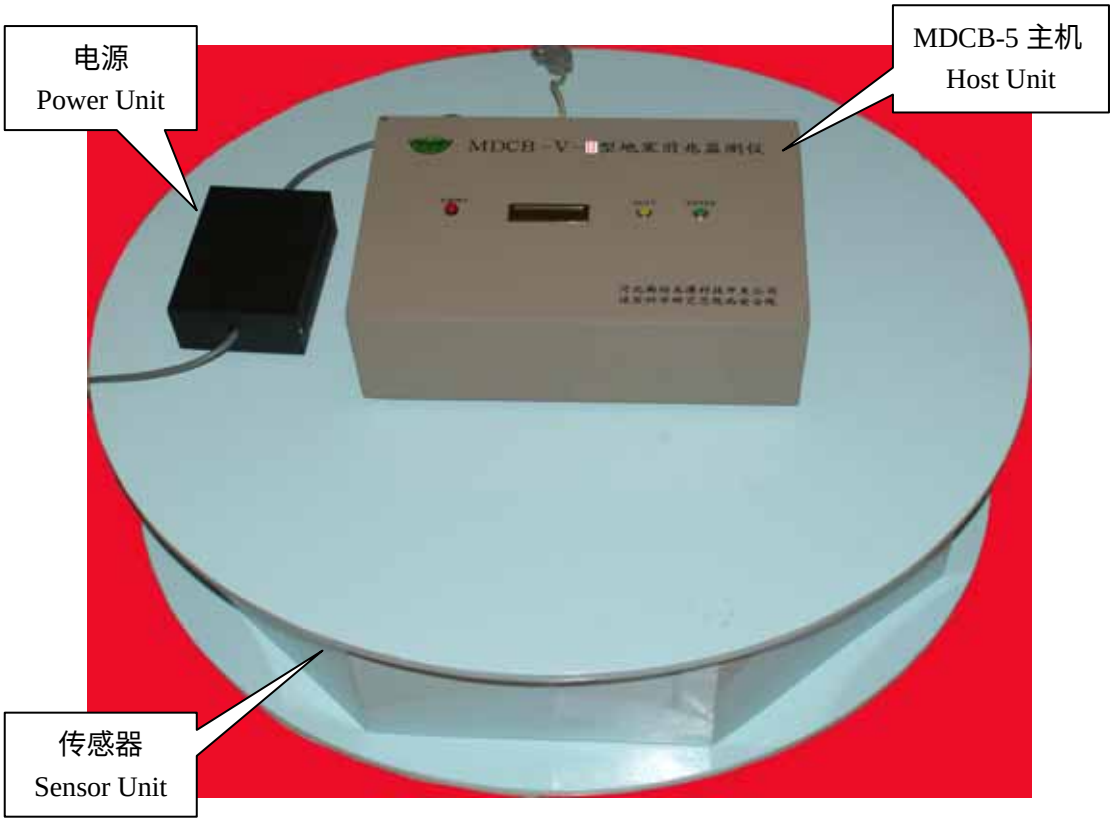
MDCB-5 and MDCB-6 型仪器主要由〔1〕主机；〔2〕传感器；〔3〕电源；〔4〕计算机〔可以由用户配备〕；〔5〕电缆〔传感器→主机；主机→计算机〕组成。下面以 MDCB-5-2 型仪器为例进行介绍。

The MDCB-5 and MDCB-6 instruments consist of the (1) host unit; (2) the sensor unit; (3) the power unit, and (4) a computer (could be equipped by the user); (5) Cables (Sensor unit → Host unit; Host unit → Computer). We herewith use the MDCB-5-2 instrument as example for introduction.

5.1 MDCB-5-2 型地震前兆监测仪主要技术参数：

5.1 The MDCB-5-2 EQ Precursor Monitoring Instrument Specification

前置放大阻抗[23]：>1MΩ (1 Meg Ohm) Impedance of preposed amplifier >1MΩ	选频范围：1-30 Hz Frequency range: 1-30 Hz
工频抑制比：20db Power frequency rejection ratio: 20db	整机功耗：1W Power consumption of the whole instrument: 1w
采样速度：160μs Sampling rate: 160μs	整机增益：70db The gain of the whole instrument: 70db
电源：220V; 50Hz Power unit power connection: 220V; 50Hz	主机电源：12V Host power: 152V
主机体积：330mm x 285mm x 200mm MDCB-5 instrument unit dimension: 35×250×28cm	主机重量：4kg± MDCB-5 Host unit – Net weight: 4Kg±
传感器体积：90×90×40cm MDCB-5 Sensor unit - dimension: 90×90×40cm	传感器重量：重量：25kg± MDCB-5 Sensor unit – Net weight: 20Kg±
传感器：总共 33 个平板式传感器单元，32 个传感器单元固定于 32 个方向 45 度斜向地面，第 33 个传感器固定向下朝向地面。 MDCB-5 Sensor unit: Total 33 plate shape sensor components, 32 fixed in 32 directions 45° towards ground; plus the 33rd sensor component fixed downwards towards the ground.	

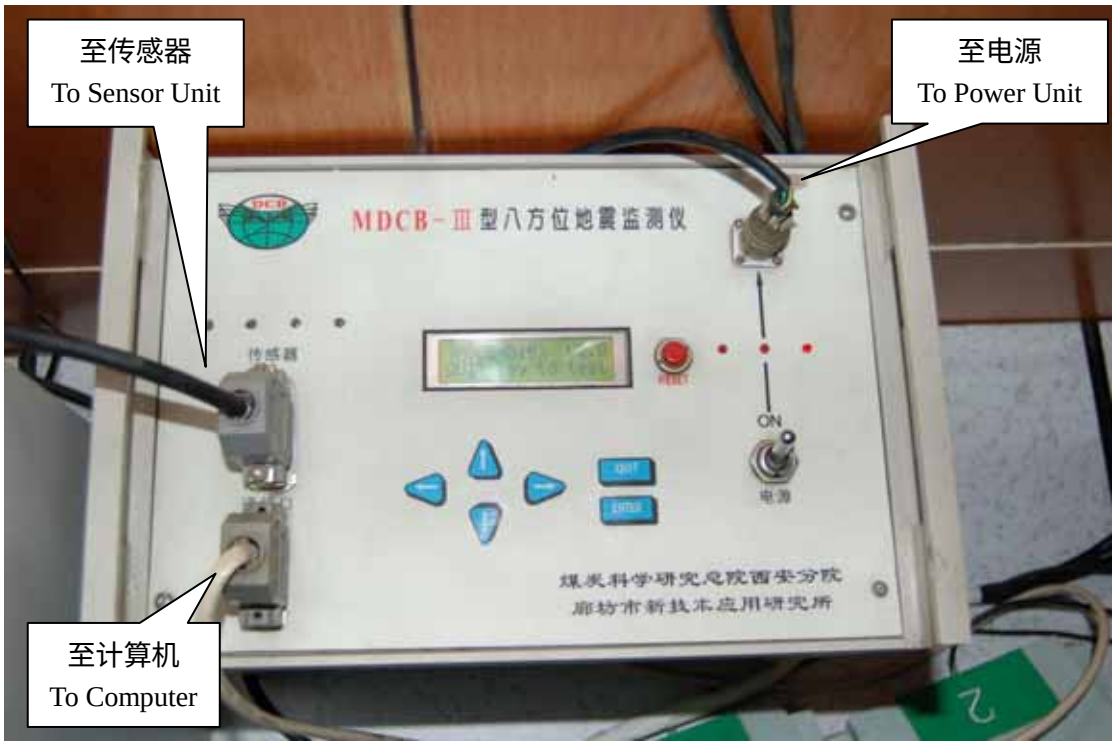


相片 1. MDCB-5-2 型临震信息监测仪

Photo 1. The MDCB-5-2 Instrument

(32 个传感器单元固定于 32 个方向 45 度斜向地面，第 33 个传感器固定向下朝向地面。)

(Total 33 plate shape sensor components, 32 fixed in 32 directions 45° towards ground; plus the 33rd sensor component fixed downwards towards the ground.)



相片 2. MDCB-3 型仪主机外观〔与 MDCB-5 型类似〕

Photo 2. The top appearance of host unit of MDCB-3 Instrument (similar to MDCB-5)

相片 3. MDCB-5-1 型临震信息监测仪的传感器〔拿掉盖〕：向下 45°的 8 个壁中有 9 个传感器元件〔仅可看到引线〕；底部中间可见朝下的第 9 个传感器元件。

Photo 3. The sensor unit (without lid) of MDCB-5-1 Instrument: 9 sensor components are installed in the 8 walls 45° towards the ground; the 9th sensor component is at the bottom facing downwards in the middle.

相片 4. MDCB 仪主机与能够上网的计算机连接。

Photo 4. The MDCB host unit is connected to a computer which can visit the Internet.

5.2 MDCB-6 型地震前兆监测仪

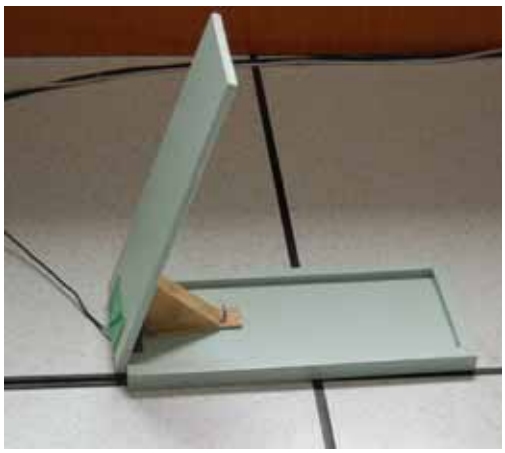
5.2 The MDCB-6 EQ Precursor Monitoring Instrument

仪器主机样式和技术参数基本同 MDCB-5-1 型仪器，在地震危险区周围的台站（俗称近区分台站）使用该仪器。仪器一般放置在距地震危险区 150 公里以内。仪器配备 8〔或 32〕个传感器单元，各自的朝向位置与角度可调，由专业技术人员定向、定深度对准未来震源区不同深度不同部位，见照片。

The appearance of the host unit and technical specifications is the same as the MDCB-5-1. This instrument is installed and operated at stations nearby and around EQ risk areas (EQ risk area nearby sub-stations). The instrument is normally installed within 150 km from the EQ risk area. The instrument is equipped with 8 (or 32) individual sensor components, the pointing direction and inclination angle of each sensor components is individually adjustable, adjusted by professional technical personal pointing towards different positions at different depths of the focal area, refer to the photo.

相片 5. MDCB-6 型仪的 8 个可调式传感器元件：调至对准已确定的震源区的不同部位。

Photo 5. The 9 sensor components of the MDCB-6 model instrument: Adjusted to point towards different portions of the identified focal area.



相片 6. MDCB-6 型仪的一个可调式传感器元件。

Photo 6. An adjustable sesnsor components of the MDCB-6 Instrument.

6. 仪器的安装
6. Installation of the instrument

MDCB 仪器及其传感器对于一般的工业电磁场有非常好的抗干挠能力。如上边的相片所示，MDCB 仪的主机及其传感器 、电源、以及配备的计算机一起全部放在任何适合于通常计算机长期工作的任何低层或高层办公室环境，完全不需要绝大部分其它地震监测仪器所需的任何地下设施，不需要在地下设施或远离城市的山洞里安装传感器，更不需要从地下设施连接到地面工作的计算机的电缆。

The MDCB instrument and its sensor unit have very good interference resistance to normal industrial electrical fields and industrial electromagnetic fields. As shown in the photo above, the MDCB host unit together with its sensor unit, power unit and the equipped computer are all installed in any low floor office environment suitable for computers to operate on long-term, and absolutely do not require any underground facilities required by most other seismic monitoring instruments, do not need to install the sensor unit in underground facilities, and do not need to any cables from underground facilities connecting to computer operating above ground.

首先将传感器放在要安装的办公室地面上，传感器的正东南西北方向要用精确的罗盘仪器校正，最好用经纬仪校正；将主机放在传感器上面，传感器的电缆插头插到主机传感器插座上；主机的传输线与微机上面的 COM1 口相接；再将电源的输入端接上 220V 交流电，输出端接到主机的电源插座上。打开电源开关、仪器主机开关后，仪器进入正常监测状态。

First install the sensor unit on the floor of the office, the E-S-W-N direction of the sensor unit is calibrated with an accurate compass; put the instrument host unit on the top of the sensor unit, insert the cable of the sensor unit to the host unit socket; connect the data transmission cable of the host unit to the COM1 data port of the computer; connect the supply power cable of the power unit to 220V 50Hz power supply (or to an appropriate power converter if the local power is not 220V 50Hz) and the power outlet cable from the power unit to the power socket of the host unit. Press on the on/off switch of the power unit and the on/off switch of the host unit, the instrument thus should enter normal monitoring conditions.

仪器开机后立即进入正常监测状态，此时主机屏幕上显示：

After the host instrument starts operation it will immediately enter normal monitoring conditions, the screen of the host unit will show:

mdcb-5（32） V 2.0 QUIT key to test

当仪器数据采集完毕，自动将采集的数据传给微机。仪器每 20 秒采集一次数据。不用人工管理。每天仪器自动形成一个以日期命名的数据文件保存下来。

Upon completion of collecting the data, the host unit will automatically transfer the collected data to the computer. The instrument shall collect data every 20 seconds. Without any manual operation, the instrument shall automatically form a daily data file which is stored by the software program installed onto the computer.

MDCB-5-1（8 方位）仪器的传感器和地面成 45°角，按 E、NE、N、NW、W、SW、S、SE 8 个方向分布，分别监测台站周围各方向上的震源区每天活动的次数，根据异常活动的幅度和次数判断台站周围哪个方向在最近 7 天之内可能发生几级地震。MDCB-5-2（32 方位）仪器同上。MDCB-6 型仪器的传感器元件根据计算的方位角和倾角来安装。这些方位角和倾角指向附近震源区的不同部位，利用 DYL 仪器进行地应力测量普查确定具体震源区位置。

The 8-sensor components of the sensor unit of the MDCB-5-1 (8-orientations) are fixed to 45 degrees inclined to the earth surface, distributed in 8 directions, i.e. E, NE, N, NW, W, SW, S and SE, respectively monitoring the number of activities each day in focal areas in each above directions. The magnitude of future EQs likely occurring in which direction in the coming seven (7) days is determined by the cycles and amplitudes of the daily anomaly variation of the respective focal area. The hoist unit and power unit and specifications of the MDCB-5-2 (32-orientations) is similar to the MDCB-5-1, the orientation angle and the inclination angle of the sensor components will be adjusted and fixed according to calculations of directions pointing to a series of portions of the nearby focal area identified during the terrestrial stress measurement survey by the DYL instrument.

7. 数据的处理

7. Data processing

MDCB 型地震前兆监测仪数据处理提供的是 Windows 98/ME/2000/XP 下的处理软件。在微机中先由工作人员安装采集程序和处理程序。采集程序运行后，微机的屏幕上立刻显示出采集数据的图形。平时将该图形最小化即可，以便随时可以观察分析（注意：微机不关机）。用户为此也应当为微机配备不间断电源。

Data processing programs are provided operating on Windows 98/ME/2000/XP for processing the data monitored by the MDCB EQ Precursor Monitoring Instruments. The staff installs the data collection program and processing program onto the computer. After the data collection program is operating, the data processed graphs will appear on the computer screen. During observation and analysis, these graphs are kept active and normally kept minimized to view them whenever necessary (Note: The computer is kept operating all the time, never turned off). For this reason, the user should also equip the computer with non-interruption power supply.

点击微机屏幕上的处理程序图标，程序处理窗口出现。点击左侧左上角第一个图标（数据处理）后，选中文件框中的日期即可显示处理的当天数据图形，有 16 种图形，10 种数据表，如果需要保存或打印某图形，点击左上角第二个图标为保存，点击文件中的“打印”可打印。

Touch the Data Processing icon on the screen, the Data Processing window will show-up. Then touch the 1st icon on the top-left (Data Processing), by selecting the date can view all the data processed graphs and tables of the date, which includes 16 graphs and 10 data tables. From the Save icon and Print icon can save or print any graphs.

后边附录中列出全部 16 种图形，10 种数据表。

All these 16 graphs and 10 data tables are listed and illustrated in the Appendix at the end.

8. MDCB 预报地震系统的工作程序

8. The MDCB Predict EQ System – Work Procedures

8.1 区域地应力普查

8.1 Regional terrestrial stress measurement survey

使用 DYL 型地应力探测仪对研究工作区及其外围进行 5 Km、7 Km、10 Km 三个深度地应力普查。确定未来发震地点、震级和近区分台站的台址。

Use the DYL terrestrial stress exploration measurement instrument to conduct terrestrial stress general measurement survey, at three depths, i.e. –5km, -7km and –10km, over the targeted area and neighboring areas to be studied/protected, determine the focal areas where future EQs will occur and their magnitudes, as well as determine the locations where EQ risk close-by observation stations should be established.

8.2 建立区域性、全国性、全球 MDCB 联网监测

8.2 Establish regional, nationwide and global MDCB monitoring network

MDCB 型仪器的特点是仪器监测的资料在世界范围内都可以通用。一般联网的形式如下：

A feature of the MDCB instrument is the data monitored and recorded by all MDCB instruments can be commonly used worldwide, regardless the location where the MDCB instruments are installed.

根据 10 余年预报地震的经验，西安地理位置是建立全球 MDCB 法联网的中心台站，其它国家作为全球联网的分台站，每个国家又可以作为该国家或邻国的中心台站，该国内或邻国的其它台站作为近区分台站，其它国家的中心台站都可以作为该国家中心台站的远区分台站。如果这个国家幅员辽阔，可以参考中国的模式。

According to the over ten years of EQ prediction practicing experience, the geographic location of Xian makes it appropriate established the Central Station of a global MDCB network. Regional MDCB networks would be established in other geographically larger nations, or covering a number of geographically smaller nations, each such regional MDCB network will be established with their own Regional Central Station. The MDCB stations within a regional network will act as nearby-stations to the nearby focal areas, and to focal areas within this regional network other MDCB stations in other regional MDCB networks would act as remote-stations. Directly, as well as through the central station of each regional network, all data will be reported to the Xian MDCB Central Station of the global MDCB network.

在中国西安台站作为中国地震局的中心台站，其它各省省局的仪器可以作为分台站；各省局的台站又可以作为该省的中心台站；各地、市局的台站又可以作为该省的分台站。

At the same time, the Xian MDCB Central Station will also act as the Central MDCB Station to the Seismology Bureau of China, and MDCB instruments operating in other provincial capital seismology bureaus will act as sub-MDCB stations of the China MDCB network.

如果某省某个地区潜伏着地震危险区，需要跟踪监测，那么该省地震局可以确定该省某个台站为中心台站，围绕潜伏的震源区周围的台站就作为近区分台站，邻近区域省、市地震局或外省地震局的台站都可以作为远区分台站。

If a hidden focal area exists within a certain province, the provincial capital seismology bureau will designate a specific MDCB station to act as the central stations of the MDCB network to follow-up with monitoring seismic activities of this hidden focal area, and other nearby MDCB stations will act as nearby-stations, and MDCB stations of neighboring province and cities, as well as in other provinces, will act as remote MDCB stations to this regional central station.

一般来讲，研究本地区的震情，本地区的台站就作为中心台站，其它台站根据距离的远近分别作为近区分台站或远区分台站。这样由中心台站、近区分台站、远区分台站进行联网监测，就是 MDCB 法几大特点之一。

In general, for studying seismic activities within the local area, MDCB stations within or close to the local area should act as the central station, and MDCB stations in other areas, and other MDCB stations, according to their distance can be classified as sub-stations of nearby-areas or sub-stations of remote-areas. Therefore, monitoring achieved by central stations, sub-stations of nearby-areas and sub-stations of remote-areas, is one of the main features of the MDCB network.

8.3 MDCB 查震报震法专家系统

8.3 The MDCB Check EQ – Prediction EQ Method Specialist System

8.3.1 MDCB 查震报震法分台站工作程序

8.3.1 The MDCB Check EQ – Predict EQ Method – Sub-station Work Procedures

1) 研究图 1　观察图形有无临震信息，是近震前兆，还是远震前兆？
1) Study Graph No.1: Observe and identify if there is any EQ imminent information, if appears, is it precursors for EQs developing in nearby areas, or in remote areas?
2) 研究图 2　对图 1 的结论加以确认。
2) Study Graph No.2: Verify and confirm conclusion from studies of Graph No.1.
3) 研究图 3、4、8 、13 观察图形近期有无临震信息，是近震前兆，还是远震前兆？
3) Study Graph No.3, 4, 8 and 13: Observe and identify if there is any recent EQ imminent information, if appears, is it precursors for EQs developing in nearby areas, or in remote areas?
4) 研究图 14　观察图形近期有无临震信息，是近震前兆，还是远震前兆？
4) Study Graph No.14: Observe and identify if there is any EQ imminent information, if appears, is it precursors for EQs developing in nearby areas, or in remote areas?
5) 研究图 11　对确定的远震信息加以确认。
5) Study Graph No.11: Further verify and confirm the EQ imminent information for EQs developing in remote areas?
6) 研究图 6　观察异常变化比率最大的方向是那个方位角？某个方向是否在连续变化中有突变，确定未来发震方向？
6) Study Graph No.6: Observe the direction from which receives the maximum ratio of anomaly variation, and determine its azimuth angle? Also observe if there are sudden dramatic changes in continuous variations from a specific direction, and determine the direction along which future EQ might occur?

7) 研究图 9， 从前几天的变化趋势研究某一方向是否要发震。
7) Study Graph 9: Based on the anomaly variation trend during the past few days to study if an EQ might occur in a specific direction?
8) 研究表 2 观察 “参数表”中的“QYY”变化和“EQL”的大小，研究未来地震的震级大小和距台站的远近。
8) Study Table 2: Observe the variation of “QYY” and the levels of “EQL” in the Parameter Table, study the magnitude level of the future EQs and their distances to the MDCB stations.
9) 研究表 5 研究“震前异常参数对照表和已经发生的震例对照表”判断哪些方向可能发震，发震的地点和未来震级大小。
9) Study Table 5: Compare the “Corresponding Table of pre-EQ anomaly parameters and already occurred EQ cases”, judge in which directions EQs might occur, the location of the developing Eqs, and their magnitude levels.
10) 将研究结果上报中心台站。
10) Report the study results to the central station.

8.3.2 MDCB 查震报震法中心台站每天研究震情工作流程
8.3.2 The MDCB Check EQ – Predict EQ Method – Central Station Work Procedure

调用处理程序 1：查找上一天世界上发生 Ms5.0 以上、国内 Ms4.0 以上的地震位于观测台站方位角；
Apply Program #1: Check all EQs ≥Ms5.0 occurred in the world and all EQs ≥Ms4.0 occurred within China during the past day, verify the azimuth angles to the central station they occurred.

1. 调用程序 2：粗略判断某台站未来 7 天可能发生地震的方位角；
2. Apply Program #2: Roughly judge the azimuth angles to the respective stations in which EQs might occur during the next 7 days;

2、利用上面两个程序的结果填写某台站异常参数与震例对应表；
3. Use the results from both above programs #1 & 2, fill-out the Corresponding Table of anomaly parameters and EQ cases related to the respective MDCB station;

3、调用处理程序中的表 10：精确计算某台站未来 7 天之内将要发生地震的方位角；
4. Apply Table 10 of the program: Accurately calculate the azimuth angle to the respective MDCB station in which EQs might occur during the next 7 days;

4、调用程序 2：查找与某个台站匹配的其它台站将要发生地震的方位角；
5. Apply Program #2: Check azimuth angles of other MDCB station corresponding to the azimuth angle of the MDCB station in which EQs might occur during the next 7 days;

5、综合分台站的意见，确定交汇时的方位角；
6. Comprehend the analysis opinions from each sub-station, and determine the intersected azimuth angle;

6、调用程序 3：利用交汇程序交汇未来震中；
7. Apply Program #3: Apply the intersection program to intersect the epicenter area of the future EQs;

7、 综合远区台站对该震源区临震信息的研究成果，确定该震源区是否在最近几天发震。

8. Comprehend the study results of the remote-stations on their analysis of the EQ imminent precursor information monitored from the focal areas, determine if EQs will or not occur within the next few days at such focal area.

8、调用程序 4，用震级计算程序计算未来发震地点的震级；

9. Apply Program #4, use the Magnitude Calculation Formula to calculate the magnitude level of future EQs to occur at the determined focal area;

9、将确定的发震方向或发震地点研究结果以分台站的名义向不同国家、地区的中心台站通报震情的研究结果。

9. In the name of the respective sub-station, report the determined EQ going to occur directions and/or epicenter area location, as well as result of seismic activity studies, to the respective central MDCB stations in the respective countries, regions.

9. MDCB 地震前兆监测预测系统的局限性及其克服办法

9. The limitations of the MDCB EQ Precursor Monitoring & Prediction System and methods to overcome such limitations

9.1 震源区产生的脉冲电磁波传播方向特性造成的局限性及克服的办法

9.1 Limitations caused by the orientation transmission characteristic of pulse type electromagnetic waves generated within the focal area and method to overcome

在发震之前，震源区内的岩石发生破裂时产生的脉冲电磁波将有如下传播方向性，如下图。据此人们可以推论出：

Before the occurrence of the EQ, pulse type electromagnetic waves generated during the fracturing of the rock body within the focal area indicate an orientation as illustrated. Accordingly, can deduce the following:

(1) 震源区内岩石体沿着基准破裂面〔主破裂面〕产生的脉冲电磁波最强，其次为沿着次破裂面产生的脉冲电磁波。换句话讲，沿着基准破裂面、次破裂面以外的其它方向的脉冲电磁则相对微弱，MDCB—5 型仪器难于或无法接收监测到它们。

(1) The pulse type electromagnetic waves generated along the basic fracture plane (primary fracture plane) from the rock body within the focal area are the strongest, along the secondary facture plane are secondary strong. In other words, the pulse type electromagnetic waves generated along directions other than the basic fracture plane and secondary fracture plane are relatively weak, the MDCB instrument is difficult or can not receive and monitor pulse type electromagnetic waves in other directions from the focal area.

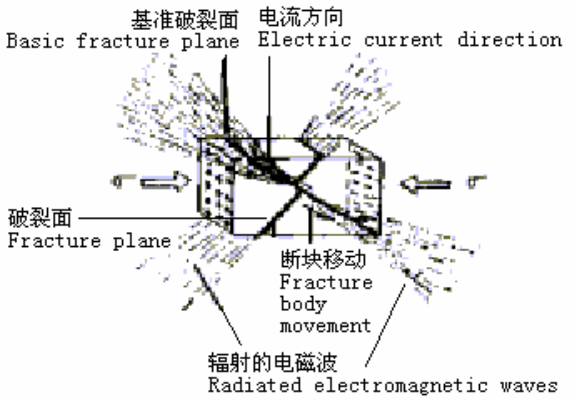


图 6 在地震发生前夕，震源区内产生的脉冲电磁波在地球某一剖面分布示意图

Fig.6 The crust-sectional distribution of the pulse type electromagnetic waves generated within the focal area on the before EQ occurrence

(2) 此外，震源区内产生的电磁波在地壳内部、大气层中传播时，在电离层、地面、莫合面三个明显的界面处可以有多次反射；

(2) Furthermore, when the electromagnetic waves generated within the focal area transmit through the crust and the atmosphere, they would encounter multiple reflections at three obvious interfaces, i.e. the ionosphere, the ground surface, and the Mohr surface;

这就造成地面上某些部位就存在电磁波通过的强区、弱区和空白区；

This results in different areas of the ground surface shall appear as *Strong Areas*, *Weak Areas* and *Blind Areas* defined by the situation of electromagnetic wave passing through them when generated from different specific focal area;

(3) 在传播方向上这些电磁波呈扇形分布；

(3) Along the transmitting direction, fan shape distribution of these electromagnetic waves;

距离震源区越远的台站，接收从震源区传过来的电磁波信息概率越大，反之概率越小。

For monitoring stations more far away from the focal area, the probability of receiving such electromagnetic waves is higher, vice versa lower.

为此，安装在任何地点的每一台 MDCB—5 型仪器只能接收监测它周围某些地点震源区震前产生的脉冲电磁波，而不能接收监测它周围所有地点的震源区震前产生的脉冲式电磁波信号。

Therefore, each MDCB instrument, regardless where it is installed , it can only receive and monitor pulse type electromagnetic waves generated from focal areas at certain locations around it, and can not receive and monitor pulse type electromagnetic waves generated from all focal areas at all locations around it.

克服该局限性的办法：

The method to overcome this limitation:

为克服 MDCB-5 型仪器这个弱点，研制出 MDCB-6 型仪器。该仪器就是专门监测漫反射那部分电磁波来预报台站周围附近的地震，弥补 MDCB-5 型仪器对近震前兆可能监测不到的局限性。

The MDCB-6 model instrument was developed to overcome the above weakness of the MDCB-5 model instrument, and especially to specially monitor the electromagnetic waves diffuse reflected from the focal area to predict EQs occurring nearby the observation stations, which offsets the limitation of the MDCB-5 possibly not been able to monitor the precursors of nearby EQs.

另外，战略性选择地点的尽可能多 MDCB 监测站。对于一个较大的国家来讲，或多个中小面积国家组成的跨国区域来讲，区域 MDCB 网最好有 7 – 10 个 MDCB-5 型仪器监测站，再加上采用 DYL 型仪的地应力普查专门跟踪监测已经查明的震源区，在其周围布置 4-5 台 MDCB-6 监测仪。这样就可以作到既能预报本地区的地震，又能提供远处某个地区或国家即将发生地震的临震信息。通过实施全球性质的 MDCB 联网地震前兆监测，互通临震信息预报地震的研究方法，地震预报可望在期望的短期内得到解决。

Furthermore, establish as many as possible more MDCB observation station at strategically selected locations. For a large territory nation, or a transnational region formed by a number of small or medium size nations, the regional MDCB network preferably includes 7 – 10 MDCB observation stations equipped with MDCB-5 model instruments, plus 4 – 5 MDCB-6 instruments installed around these observatory stations especially monitoring nearby focal areas identified by the DYL model instrument through follow-up terrestrial stress survey in the targeted areas. This will enable to predict EQs developing in nearby areas, as well as to provide EQ imminent information to other areas or nations on EQs imminent in their regions. Through the method of EQ precursor monitoring by a global MDCB network, analysis and exchanging EQ imminent information and prediction information with each other, the task of EQ prediction can be expected to be solved within expected time.

9.2 MDCB 网进行每周预测工作安排--地震临震前兆出现的时间--造成的局限性

9.2 Limitations caused by weekly prediction work arrangements of the MDCB network – The appearance time of the EQ imminent precursors

每个震源区震前出现临震前兆的时间不相同，亦可能出现在星期一至星期天、甚至公共假日任何一天。作为一个非官方的非收入性民间地震监测预测网，在目前缺乏资金支持的情况下，MDCB 协作网仅能支持 3-4 个地震分析预测工作人员。在完成每天必须完成的基础数据分析工作条件下，MDCB 网目前只能做到每星期三做一次每周预测。如果某个震源区的临震前兆在 MDCB 网星期三完成分析预测之前没有出现而是在完成该次预测之后出现，该震源区的地震又在下周星期三之前发生，对该震源区发生的地震通常会漏掉。

The time when the EQ imminent precursor appears is different for EQs occurring at each focal area, and such imminent precursors could appear on any day during Monday to Sunday, or any day during public holidays. As a non-governmental EQ monitoring prediction network without any revenues, the MDCB network can only support 3 – 4 EQ prediction analysts. Under the situation of completing the basic daily data analysis work, the MDCB network can only afford to make weekly predictions each Wednesday. If the EQ imminent precursor appears at a focal area appears after the MDCB network has completed their analysis and prediction on Wednesday, and the EQ at this focal area occurs before the next Wednesday, then the prediction normally will miss the EQ occurring in such focal area.

此外，中国目前对某些公共假日实行长假制度：中国的春节、“五一国际劳动节”和“十一国庆节”将前后的星期日结合在一起放七天假。这样七天假日期间的星期三不做预测，推迟到公共假日后下一个星期三再做。这样，这七天后期期间发生的地震通常也可能漏掉。例如，2005 年 10 月 7 日在巴基斯坦发生的强震，尽管从多个台站监测记录到的前兆信息能够预测，由于震前的没有做周预测，该地震非常遗憾地漏报了。

Furthermore, China at present adopts a system of long holidays on certain public holidays: There are 7-days holiday, by integrating the weekends before and/or after, for the Spring Festival, the May 1st International Labor Day, and the Oct. 1st National Day. The Wednesday prediction is not conducted during such public holidays, and postponed to the next Wednesday after the public holiday. Accordingly, some EQs occurring during such 7-days holidays might also be missed. As an example, the strong Pakistan EQ occurring on Oct. 7, 2005, although it's precursors were monitored and recorded by a number of MDCB observation stations, due to the Oct. 1st National Day holidays no Wednesday prediction made before the occurrence of this EQ, it was unfortunately missed.

克服该局限性的办法：

The method to overcome this limitation:

增加分析预测工作人员，包括通过多个区域性 MDCB 网分析预测工作的协作，每周进行两次以至三次预测，以至每天进行预测分析。

Increase the number of analyst staff, including through collaboration of analysis and prediction work between multiple regional MDCB networks, each week conduct 2 or even 3 predictions, and even daily prediction analysis.

9.3 没有采用 DYL 型地应力探测仪对地震危险区进行测量的地区或国家，事先必须要进行大区域深层地应力测量普查

9.3 Did not in advance conduct the very necessary large area deep depth terrestrial stress measurement survey with the DYL instrument

如 2.1 节介绍的那样，完整 MDCB 查震报震法的第一步是采用 DYL 仪进行非常必要大区域深层地应力测量普查，事先将该区域存在的潜在地震危险区的位置确定出来。

As introduced in section 2.1, the 1st step of the complete Check EQ – Predict EQ Method is to conduct the very necessary large area deep depth terrestrial stress measurement survey with the DYL instrument, to determine the location of EQ risk areas within the area.

事先将该区域存在的潜在地震危险区的位置确定出来，就能够在 MDCB 网进行全方位监测的同时，才有可能采用 2.3 节中介绍的 MDCB-6 型仪器专门监测这样的地震危险区震情的趋势变化，及时捕捉临震信息。

By identifying the location of EQ risk areas within the area, could then, at the same time conducting full orientation monitoring by the MDCB network, also use the MDCB-6

instrument, introduced in section 2.3, specially monitor the focal area possibly hidden in such EQ risk areas, and timely catch the EQ imminent information.

克服该局限性的办法：

The method to overcome this limitation:

采用 DYL 型仪事先进行非常必要的大区域深层地应力测量普查。

In advance conduct the very necessary large area deep depth terrestrial stress measurement survey with the DYL model instrument.

9.4 工作不够认真导致的分析预测工作人员人为失误

9.4 Human errors by the staff of analysts not working earnest enough

MDCB 地震监测预测系统与 MDCB 查震-测震法中尽管已经最大限度采用许多计算机技术、自动化软件程序，依然还有许多工作必须依靠分析预测工作人员来完成。工作不认真，执行工作规范不严格，均会造成人为失误。

The MDCB EQ monitoring and prediction system, as well as the MDCB Check EQ – Predict EQ Method, although to great extent has adopted computer technology, software programs, but there is still a lot of work to be conducted by the analyst staff. Working not earnest enough, implementing the work norms no strict enough, will also cause human errors.

克服该局限性的办法：

The method to overcome this limitation:

加强对分析预测工作人员的培训与教育，加强他们对于本国人民与世界人民生命安全的社会责任感，建立科学合理的考核制度、奖惩制度。

Enhance training and education of the analyst staff, enhance their social responsibility on the life safety of people of their nation and the world, establish scientific and reasonable assessment systems, reward and punishment systems.

9.5 更准确更可靠预测地震“三要素”的局限性及其克服办法

9.5 Limitation in more accurately and reliably predicting the occurrence time, location and magnitude of EQs and methods to overcome such limitation

任何地震预测技术都有其优势、弱势与局限性。综合性提高地震预测准确性与可靠性的最有效方法是多种手段、技术、仪器、方法的长期预测、中期预测与短临预测的综合协作。MDCB 网目前正在做这方面的努力。但是，综合有效这样实施的前提是政府有关部门的大力支持与跨国区域性合作以及至关重要的全球合作。

Any EQ prediction techniques have their advantages, weaknesses and limitations. The most effective method to comprehensively increase the accuracy and reliability of EQ prediction is comprehensive collaboration between long-term prediction, medium-term prediction and short-term/imminent prediction by multiple means, techniques, instruments, methods. The MDCB network is making efforts in this respect. However, the precondition of such effectively implementing such comprehensive collaboration is strong support by the concerned governmental departments, transnational regional cooperation, and most essential global cooperation.

后注： 欲了解与每节有关更详细的内容，请参看编者关于有关问题的详尽论文，以及专著“怎样预报观测台站周围及国内外最近 7 天地震”〔陕西人民出版社，2006 年 7 月〕。

Note: To learn more details of each section, please refer to the detailed technical papers on each subject and the editor’s monograph: How to Predict Earthquakes Occurring in the Next 7 Days Nearby the Observation Stations, in China and Abroad, Shanxi People’s Publishing House, July 2006.