新しいネットワーク MT 法観測機器の開発と中部地方における観測計画

Development of new instruments for the Network-MT survey, and its experimental plan in Chubu district

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Abstract

In order to obtain voltage difference and geomagnetic records with 10Hz sampling in the Network-MT surveys, we developed new observation systems. For both electric and magnetic observations, we modified or improved existent old observation systems. In the new system, we can continuously acquire 10Hz records and transmit them via various kinds of LAN.

In Chubu district, there runs the Niigata-Kobe tectonic zone in its backarc side, seismic and volcanic active zone beneath the Northern Japan Alps, and low-frequency seismic zone of non-volcanic origin in its forearc side. All these crustal activities are considered to be directly or indirectly related to the existence or movement of the crustal fluids such as water or melt. Electrical conductivity is an undeground physical property which is sensitive to the existece of such crustal fluids and their connectivity. Thus, aiming at elucidating mechanism of the various kinds of crustal activities occurring beneath Chubu district, we have started the Network-MT survey to determine regional and deep electrical conductivity structure down to the upper mantle.

In this paper, we introduce new observation systems, total plan of the survey, and preliminary results from the first datasets which we have just started to obtain since the end of Dec., 2005 in a survey line from Shitsuura, Ishikawa Prefecture on Noto Peninsula to Kamitakara, Gifu Prefecture.

要旨

ネットワーク MT 法観測における地電位差観測・磁場観測において，データ取得サンプリングレートを 10Hz まであげるため，新しい観測システムの開発を行った．地電位差観測については，既存のアドシステムズ社製測定装置 SES93 に付加するデータサーバを開発し，ADSL や ISDN 回線を用いて転送するシステムを開発した．また，これに対応した磁場観測を行うため，従来のテラテクニカ社製 U36 型３成分 fluxgate 磁力計を改造し，ADSL や ISDN，衛星 LAN を用いてデータ転送を図るシステムを構築した．これにより，連続して 10Hz サンプリングで電磁場データを取得できるようになった．

これらの観測機器を用い，新潟ー神戸歪集中帯を含む中部地方背弧域の３次元広域深部電気伝導度構造を求め，歪集中のメカニズムや同地域に存在する北アルプス活動帯，非火山性低周波微動の成因を明らかにする目的で，石川，富山，福井，岐阜，長野の５県にわたってネットワーク MT 観測を実施する

計画をたてた（Fig.1）．各県の NTT 及び関連会社の協力を得て，2005 年度中に，Fig.1 に示したすべての電極点での鉛－塩化鉛電極埋設を終了し，2005 年 11-12 月にかけて，WJM，KTJ，OSK の 3 点に磁力計を設置し，石川県七浦から岐阜県神岡に至る１６中心点において地電位差観測を開始した（Fig.2）．

観測開始から，ほとんど磁気擾乱の無い静穏な状況が続いたが，2006 年 4 月 13-15 日にかけて，やや顕著な磁気擾乱が起きた（Fig.3）．その期間について，WJM を remote reference にとって，KTJ の水平磁場に対する各測線の地電位差応答関数を Chave et al., 1987 の robust コードを用いて求めた結果，8s-10,000s に至る帯域で良好な応答関数が得られることが確認できた（Fig.4）．Fig.5 には，その初期的解析として，様々な方位をもった応答関数に，Constable et al., 1987 による 1 次元 OCCAM inversion を適用した結果を示す．跡津川断層域以南の下部地殻低比抵抗が再確認されたほか，能登半島域深部に大きな低比抵抗帯が決定された．それらは，それぞれ，Fig.3 に示した神岡ネットの数 10s 付近，中島ネットの 10,000s 付近の位相の高まりに対応している．今後は，観測点を移動して Fig.1 のすべてのネットでのデータ取得を図る．データ解析ではさらに応答関数の質を上げる一方，能登半島や富山海底谷などの複雑な海陸地形を考慮した 3 次元解析を行っていく予定である．

Figures

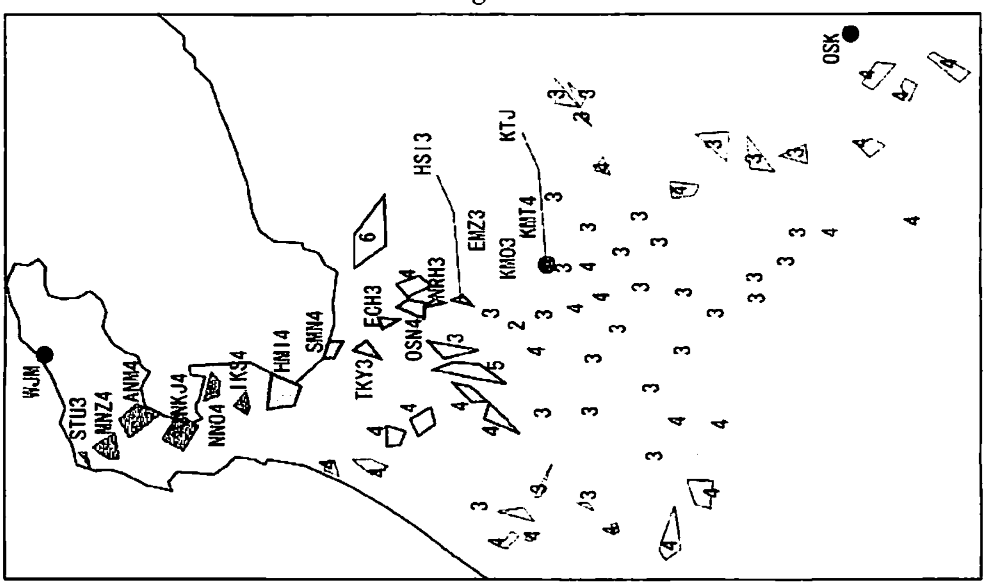

Fig.1: Plan of the Network-MT survey in Chubu district. Polygons indicate respective telephone local service areas. Numbers indicate number of electrodes buried in the respective local service areas. From Nov. to Dec., 2005, three magnetic stations (black circles, WJM, KTJ and OSK) were built. At 16 shaded areas (from STU in Ishikawa Pref. to KMT in Gifu Pref.), we have started long baseline voltage difference measurements since the end of Dec., 2005.

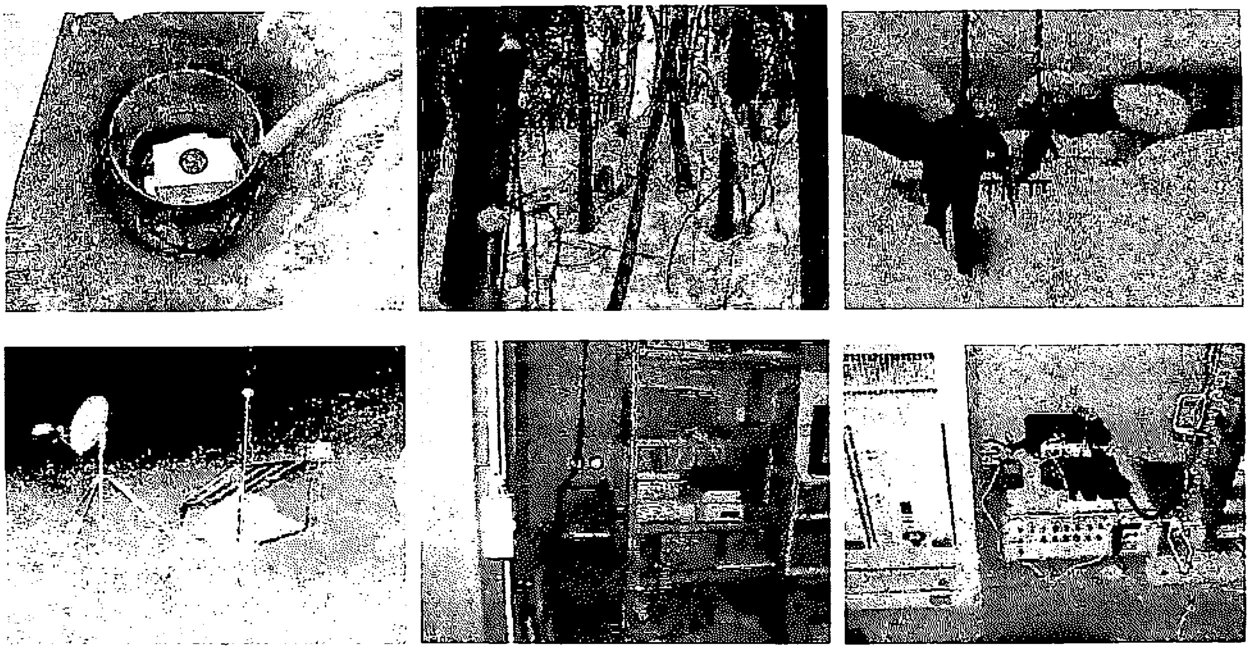

Fig. 2. Photos showing installation of newly developed instruments.

Left column: 3-component fluxgate magnetic sensor (top), and data acquisition and satellite-LAN telemeter system at OSK (bottom).

Center column: Installation of 3-component fluxgate magnetic sensor at KTJ (top), and data acquisition and ISDN-LAN telemeter system in the KTJ observatory of DPRI (bottom).

Right column: NTT repeater station at KMT (top) and voltage difference data acquisition and DSL-LAN telemeter system installed in the station (bottom).

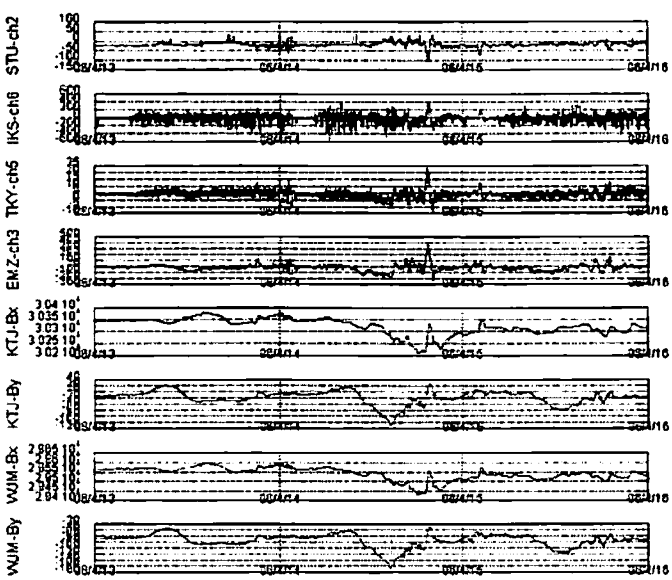

Fig. 3. Sets of 1s-sampling raw time series from 13 to 15, Apr., 2006. The upper 4 time series are voltage difference records and the lower 4 are 2-component horizontal geomagnetic records. From top to bottom, STU ch2, IKS ch6, TKY ch5, EMZ ch3, KTJ Bx, KTJ By, WJM Bx and WJM By are shown. Vertical units are mV and nT for voltage difference and geomagnetic records, respectively.

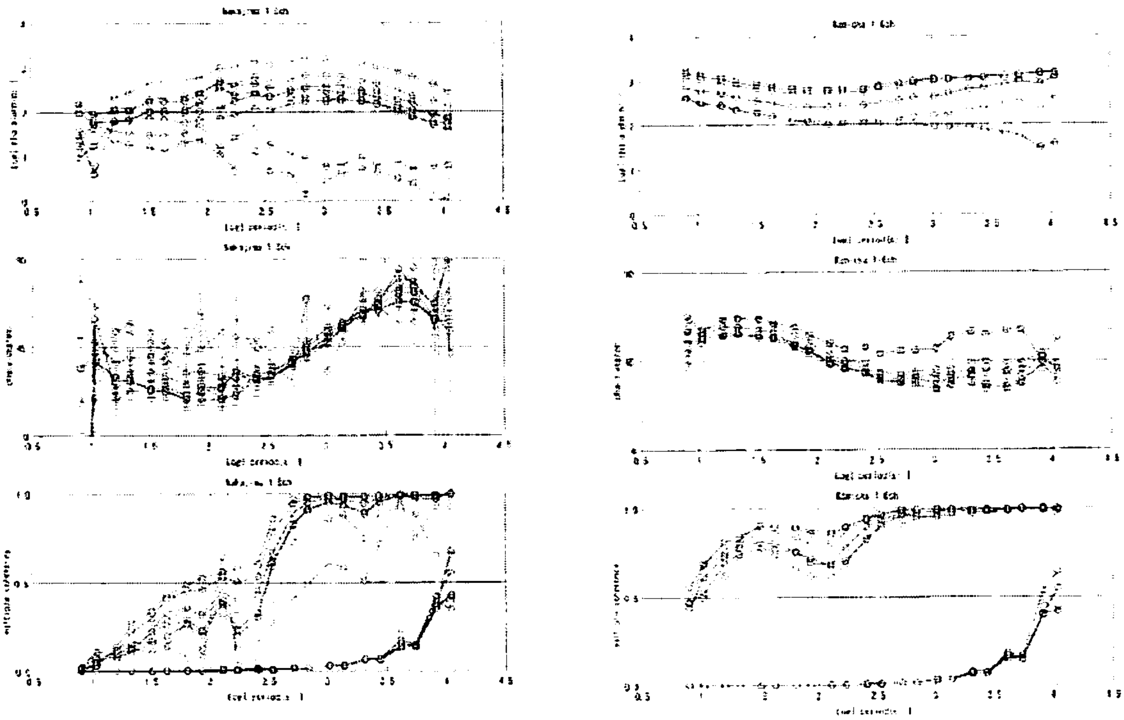

Fig. 4. Network-MT responses in NKJ (left) and KMO (right) areas. Period range is from 8s to 10,000s. For respective bipoles, responses between voltage difference in respective bipole azimuth and horizontal magnetic field in the direction perpendicular to the bipole azimuth are computed as Ichiki et al., 2001 did. From top to bottom, apparent resistivity, phase and multiple squared coherency are shown. In the coherency plot, statistical zero-coherency levels are also plotted.

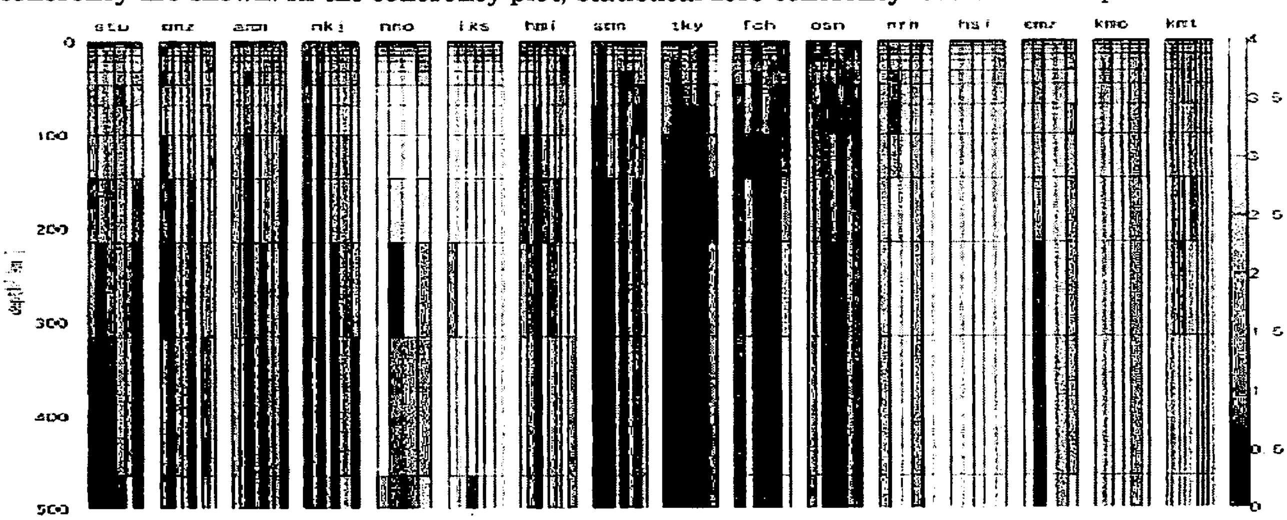

Fig. 5. Cumulative 1-D structures from STU in Ishikawa Pref. (left) to KMT in Gifu Pref. (right). 1-D structures are estimated by using all the 'mutually perpendicular Network-MT responses' shown in Fig. 4 with the aid of OCCAM 1-D inversion (Constable et al., 1987). Very low resistivity throughout depth range beneath the Toyama Plain (HMI to OSN) is probably due to static effects.

References

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