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深部找矿与蒋氏 TEM双定源回线装置方案

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摘 要: 双定源回线装置的水平场 H_x,其强度大、均匀,有利于探测深部陡倾斜金属矿藏,并可用作远距离井中测量的场源。此方案可用于危机矿山的找矿工作。

关键词: 蒋氏 TEM双定源回线装置; 危机矿山; 深部金属矿探测
中图分类号: P 631.3^{+}25 **文献标识码**: A

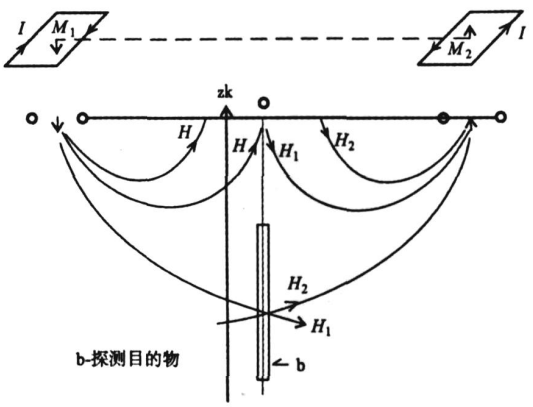
0 前言

矿山危机日益严峻,深部找矿成为当今迫切任务。瞬变电磁法是勘查金属矿的有效方法之一,但探测深度相对较大的常规大定源外装置、探测深度与源接收距有关,源接收距越大探测深度也越大,但场却越弱,另外,场也不够均匀。地 ~井 TEM是寻找井旁矿藏的重要手段,然而在矿山地区障碍较多,回线不易布置,影响地 ~井工作的开展。为摆脱这些困境,更好发挥瞬变场法在找深部矿藏中的作用,作者提出新方案:一种新的 TEM装置。

1 方案的描述

设大定源外装置观测的最大距离为 M_1O,那么在 $2M_1O$ 或 $>2M_1O$ 处再铺设同样尺寸的大回线,通以强度相等的电流,但磁矩反向,见图 1中 M_2,此即为双定源回线装置,简称蒋氏 -回线。

由图 1可见,由 M_1 和 M_2 产生的磁场向量相加,使场趋于均匀,在中部"O"点向下的断面上, $H_z=0$, H_x 比单个回线的场强增大一倍,有利于深部陡倾斜矿体的激励,而在近地表部分 H_z 强度降低,地表响应降低,另外,可观测范围比单个回线要长一倍以上。



(Loop size: 400 ×200 m, I=12.5 A)

图 1 蒋氏双定源回线装置铺设示意图

Fig 1 Schematic diagram of Jiang's dual fixed transmitter loop configuration

2 双定源回线水平磁场 H_x 特征的理论计算

设均匀大地为高阻,场的分布特点与自由空间相同,取双回线装置电流与常规大回线相等,计算结果如图 2所示 (见下页)。

图 3(见下页)为常规大定源外 H_x 断面等值线图。

对比图 2、图 3二等值线图可见,在靠近场源的地段,二种装置的等值线强度和特征相近,比如 300 μτ和 100 μτ等值线,再向深处和远离场源处,

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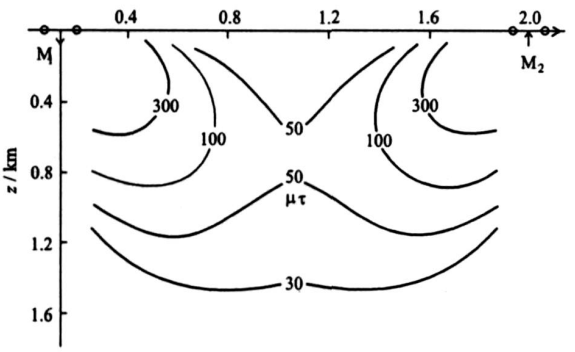


图 2 双向定源 TEM H_x 分量等值线断面图

(回线: 400 ×200 m, I = 12.5 A)

Fig. 2 H_{1x} Contour diagram along the main section of Jiang's configuration

(Loop size: 400 ×200 m, I = 12.5 A)

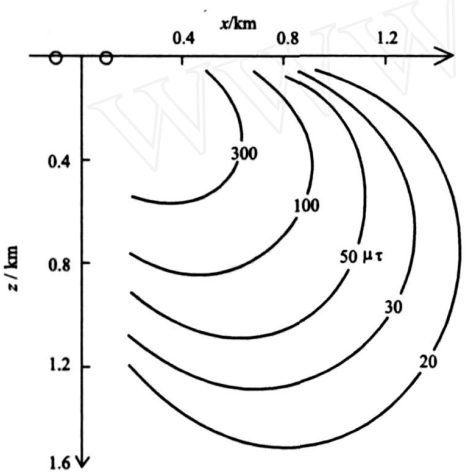


图 3 大定源 TEM H_x 分量等值线断面图

(回线: 400 ×200m, I = 12.5A)

Fig. 3 H_{1x} Contour diagram along the main section of conventional Large fixed loop configuration

(Loop size: 400 ×200 m, I = 12.5 A)

双定源的 H_x 就趋向均匀。

沿水平方向,深 300 m和 900 m H_x 强度的特点如图 4所示。该图显示了双回线 H_x 沿水平方向变化平缓的特点,图中"Tx_1"表示常规大定源装置,"Tx_1 &Tx_2"表示双定源回线装置,特别有意义的是在 x为 1 100 m～1 700 m的地段,在 900 m深度处的 H_x 强度大于 300 m深度处的 H_x 强度。

图 5表示的是 H_x 随深度的变化特征,图 5反映出图 2中 x = 1.4 km处 H_x 随深度的变化特征。在地表处, H_x = 0,而后迅速增强,在 H = 700 m处达到极大,而后缓慢减弱。

设在图 2的装置条件下,位于 x = 1.4 km下方有一直立板状体,上缘深 500 m,走向长 500 m,沿伸 300 m,时间常数 τ = 3.0 ms(有意义的视时间常数 $\tau a > 2.7$ ms),计算得出的 $B'x$和 $B'z$响应如图 6

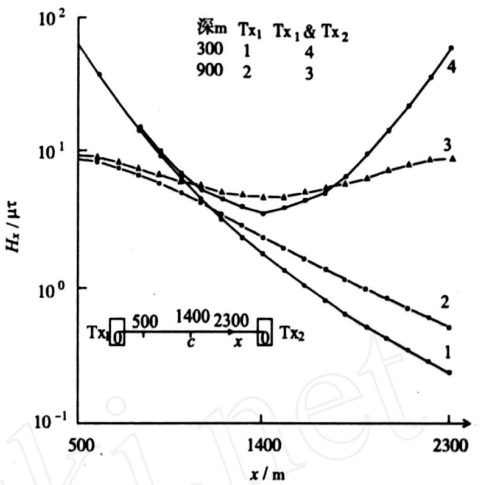


图 4 H_x 沿 x轴下深 300 m和 900 m处的强度特征

Fig. 4 Variation of H_x strength along x-axis of conventional large fixed loop (Tx, curve 1 and curve 2) and large fixed loop ($Tx1$&$Tx2$, curve 3 & curve 4), at depths of 300 m and 900 m

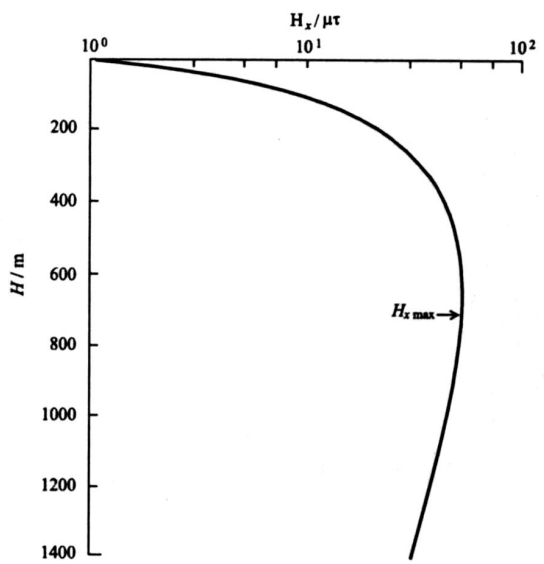


图 5 双回线中心点 H_x 随深度的变化

Fig. 5 A curve of H_x vs depth at the center of dual loop configuration

所示 (见下页)。由图 6可见, $B'x$max = 360 μv, $B'z$max = 230 μv,远大于观测精度。

上述各种计算给出 H_x 的空间特征,虽然计算的条件简单,但证实此装置有利于探测深部陡立矿体则是确定的。

3 方案的可行性与后续工作

本方案提出的新装置是现有电磁法理论与作者工作经验碰撞的火花,无须建立新的理论,而仪器也是现有的 (虽不理想),可以进行可行性试验。

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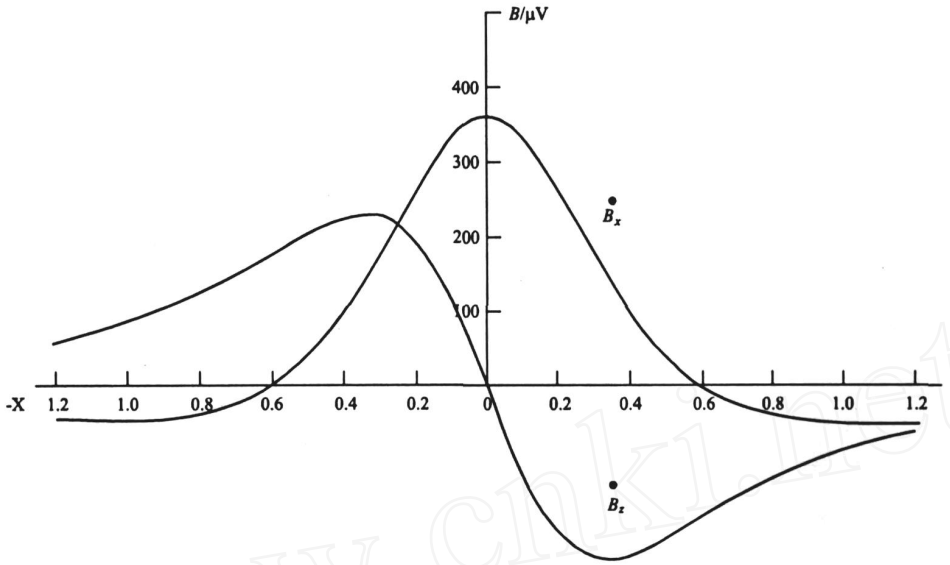


图 6　双向定源直立导电板 TEM 响应理论曲线

Fig 6　Theoretic TEM response curves of vertical conductive plate excited by dual loop

以现有仪器做实验，只能以一台发射机供电，二个回线反向串接起来，M_1M_2 距小于 2 000 m，供电电流小，铺连接电缆较麻烦，故不理想。后续的工作主要是提供非电缆的同步设备，使二台发射机各给一个回线供电，并保证同步工作。

方法上则是编制有关解释软件。

4　结论

(1)此新装置有利于深部陡倾斜和 3D 矿体的激励。

(2)此装置用于地面观测时，虽然多用一套设备可是观测面积扩大一倍以上，地表非矿干扰被压制。

(3)此装置也可做地～井 TEM 观测，以探测井间可能存在的矿体，探测深度大于地面观测，可探测矿体规模远小于地面观测所要求的大小，而常规的将钻孔布置在回线中间的做法对陡立矿体效果不理想。

该装置也适用于观测在双回线中的钻孔。

(4)对于深部水平矿体的地～井工作，如果目的物上方地形地物不适宜布设回线，也可用此方案，只需将二回线之磁矩同相，即 $\overline{M_1} = \overline{M_2}$。

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gravity anomalies have been analyzed, and with conditions suitable for each method of boundary mapping summarized.

Key words: gravity data; boundary locating; locating error; characteristic value

JIANG'S DUAL FIXED TRANSMITTER LOOP CONFIGRATION FOR DEEP DEPOSIT EXPLORATION

JIANG Bang-yuan (Institute of Geophysical and Geochemical Exploration, CAGS, Langfang Hebei 065000, China). *COMPUTING TECHNIQUES FOR GEOPHYSICAL AND GEOCHEMICAL EXPLORATION*, 2007, 29 (suppl): 0039

The horizontal magnetic field Hx due to the dual fixed transmitter loops is stronger and more homogeneous than that of conventional large fixed transmitter loop. It is suitable to detect deeply buried and steeply inclined deposits and could be used as a source for surveys in boreholes. So it could be a useful tool for ore prospecting in crisis mines.

Key words: jiang's dual fixed transmitter loop configuration; deep conducting deposit; crisis mines

THREE-DIMENTIONAL INVERSION OF ANOMALOUS DATA OF FIXED LOOP SOURCE TEM SURVEY

DENG Xiao-hong (Institute of Geophysical and Geochemical Exploration, CAGS, Langfang Hebei 065000, China). *COMPUTING TECHNIQUES FOR GEOPHYSICAL AND GEOCHEMICAL EXPLORATION*, 2007, 29 (suppl): 0042

The feasibility of 3D inversion of anomalous data of fixed loop source TEM survey has been analyzed in the paper, and with the inversion method by using modified generalized inverse briefly introduced. The flow chart of the 3D inversion of anomalous data of fixed loop source TEM survey has also been given. A test inversion result of forward modeling data show that the method is effective.

Key words: fixed loop source; transient electromagnetic method (TEM); three-dimensional inversion of anomalous data

AN ALLICATION OF TEM TO ARCHEOLOGICAL INVESTIGATION FOR METAL FUNERARY OBFECTS

WU Jun-jie, LV Guo-yin, ZHAO Jing-xi (Institute of Geophysical and Geochemical Exploration, CAGS, Langfang Hebei 065000, China). *COMPUTING TECHNIQUES FOR GEOPHYSICAL AND GEOCHEMICAL EXPLORATION*, 2007, 29 (suppl): 0047

The field procedure, data processing and interpretation of TEM survey with fixed source-loop configuration for metal funerary objects have been briefly introduced in the paper. A case result shows that the TEM with fixed source-loop configuration is effective for archeological investigation for fair-sized metal funerary objects.

Key words: Transient Electromagnetic Method (TEM); fixed source-loop; archaeology; ancient tomb; metal object

AN APPLICATION OF SPECTRUM ANALYZER TO ANALYSES OF EM NOISES IN MINES

LEI Da, LI Xiao-chang, ZHAO Fu-gang, et al (Institute of Geophysical and Geochemical Exploration, CAGS, Langfang Hebei 065000, China). *COMPUTING TECHNIQUES FOR GEOPHYSICAL AND GEOCHEMICAL EXPLORATION*, 2007, 29 (suppl): 0051

The technique of collecting electrical and electromagnetic fields mixed with EM noises by using HP3526A spectrum analyzer has been introduced in the paper. The technique has been applied for field measurements of noises in mines. Through field acquisition and spectral analyses of EM noises, the characteristics of the noisy signals could be studied, so providing a basis for developing a data acquisition technique of anti-interference EM survey.

Key words: field measurement; spectrum analyzer; interference signal; electromagnetic field noise characteristic

AN APPLICATION OF CSAMT TO PROSPECTING FOR HIDDEN MINERAL DEPOSITES

HUANG Li-jun, ZHANG Wei, LIU Rui-de (Institute of Geophysical and Geochemical Exploration, CAGS, Langfang Hebei 065000, China). *COMPUTING TECHNIQUES FOR GEOPHYSICAL AND GEOCHEMICAL EXPLORATION*, 2007, 29 (suppl): 0055

In comparison with conventional electrical methods, CSAMT is characterized by larger detection depth, higher lateral resolution and more portable facilities, and therefore has been widely adopted in mineral explorations, with rather satisfied results obtained. Introduced in the paper are some case histo-

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