

航空热红外遥感图象集

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地质矿产部地质遥感中心

地质出版社

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前 言

随着遥感技术的发展，热红外遥感已成为遥感技术中一种新的方法。它已广泛地应用于地质、海洋、水利、电力及城市环境调查等方面，并显示出其独特的优越性。

我国的航空热红外遥感工作始于六十年代末期，当时主要是研制红外探测仪器。七十年代中期，对于区域地质调查和水文地质调查等方面的应用进行了试验研究，七十年代末、八十年代初，试验领域逐步扩大到环境保护、地热、水利、电力、海洋、自然灾害和城市环境调查等方面，并在不同程度上取得了比较好的应用效果，同时也积累了一些丰富的典型图象资料。我们在总结这些资料的基础上，编汇了这本图象集，希望它能对我国今后开展的航空热红外遥感工作提供参考。

本图象集汇集的图象和解译图等295幅，共分为四个部分：

一、航空热红外遥感工作过程。用图表和示意图等形式简要地介绍热红外成象的基础知识、工作过程和主要仪器设备。

二、航空热红外扫描图象应用。介绍在区域地质调查、水文地质调查和地热调查等方面的应用效果，以及水污染、工业热流、海洋调查、自然灾害调查及城市环境监测等方面的典型图象。

三、图象处理。重点介绍经专用设备处理的各种功能增强的热红外图象，比如电子光学方法增强处理的彩色密度分割图象和专用计算机处理的图象。

四、航空热红外扫描图象影响因素分析。搜集了有关几何形变和由各种干扰因素引起的假异常图象样片，以建立识别标志。这是热红外图象解译中必须注意的问题。

在本图象集的编汇过程中，中国科学院上海技术物理研究所、辽宁环境保护科学研究所、地质矿产部岩溶地质研究所、辽宁地质矿产局遥感地质站、辽宁第二水文地质大队、天津市地质矿产局遥感地质站和北京市环境保护监测中心等单位热情地为我们提供了有关图象及解译资料，因而，丰富了这本图象集的内容；同时还得到许多从事遥感工作的专家、学者的热忱指导和帮助，对此我们表示衷心的感谢。

参加本图象集编汇工作的有：周彦儒、张振德、肖继春、王志民、李成尊、李景华和孟繁让等。

由于编汇水平所限，该图象集中还有许多不足之处，敬请读者批评指正。

PREFACE

With the development of remote sensing, thermal infrared imagery method as one of the remote sensing techniques has had wide applications in geology, oceanography, water conservancy, electric power management, urban environmental investigation and so on. Its unique advantage has been demonstrated in different aspects.

The airborne thermal infrared remote sensing in our country began in later 1960s, when the development of infrared detection instruments was dominant. Testing researches on thermal infrared applications to geological, hydrogeological and other investigations were carried on mid 1970s. Towards the end of seventies and at the beginning of eighties the test field expanded gradually to environmental protection, terrestrial heat investigation, water conservancy, electric power management, oceanography, natural hazard and urban environmental investigations. To some different degree, good results were achieved from all of the tests, as well as a lot of typical imagery data. On the basis of the data summarization, we edited this photo album. It is hoped that this book will serve as a reference to future activities of airborne thermal infrared remote sensing in our country.

The album consists of 295 images and interpretation maps divided into four parts.

I. The working procedure of thermal infrared remote sensing. The basic knowledge, working procedure and main instruments of thermal infrared imagery are briefly introduced by figures and schematic drawings.

II. The applications of airborne thermal infrared scanning images. The application results in geology, hydrogeology and terrestrial heat investigation are presented in this part, and also with typical images of water pollution, industry heat current, oceanic and natural hazard investigation, urban environment monitoring and other aspects.

III. Image processing. This part introduces mainly various function enhancement thermal infrared images processed by special instruments, the color density slice images processed by electron-optical enhancement and images processed by special computer.

IV. Analysis of influence factors of airborne thermal infrared scanning images. The pseudo anomaly images caused by geometric distortion and other influence factors are collected together so as to set up the recognition key. This must be taken notice of in thermal infrared images interpretation.

We are greatly indebted to the following organizations: Shanghai Technical Physics Research Institute of Chinese Academy of Sciences, Environmental Protection Science Research Institute in Liaoning Province, Karst Geological Research Institute of the Ministry of Geology and Mineral Resources, Geological Remote Sensing Station of the Bureau of Geology and Mineral Resources of Liaoning Province, the Second Hydrogeological Team of Liaoning Province, the Geological Remote Sensing Station of the Bureau of Geology and Mineral Resources of Tianjin and the Observing Center of Environment Protection of Beijing for their supply of pictures, images and interpretation data to rich this album, we are also deeply grateful to a lot of scholars and experts in remote sensing for their help and direction.

This album is edited by Zhou Yanru, Zhang Zende, Xiao Jichun, Wang Zhimin, Li Chengzun, Li Jinghua and Meng Fanrang.

In conclusion, it would be a pleasure to the authors to acknowledge indebtedness to the readers for their comments, suggestions and criticisms.

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一、航空热红外遥感工作过程

I. The working procedure of airborne thermal infrared remote sensing

热红外遥感所探测的波段范围为 $3-1000\mu\text{m}$ 。由于受大气传输条件的限制，它只在 $3-5\mu\text{m}$ 和 $8-14\mu\text{m}$ 两个波段范围内有较好的透射率，这两个波段范围通称为大气窗口，因而它们是热红外遥感仪器的主要工作波段。它的特点在于，不受光照条件的限制，可以昼夜成象。

航空热红外遥感工作过程如下：

1. 飞行前的准备：包括资料搜集、计划准备、测区选定、成象条件选择、飞行方案制定、成象计划实施和飞行前的地面测温等准备工作。

2. 信息获取：从空中获取的地面热红外辐射温度信息，可以是红外辐射计记录的温度曲线或数据，也可以是红外扫描仪记录的电磁信号或经过电—光转换后得到的感光胶片。

3. 回放、处理：将空中获取的信息经过地面回放处理成象后，提供用户使用。

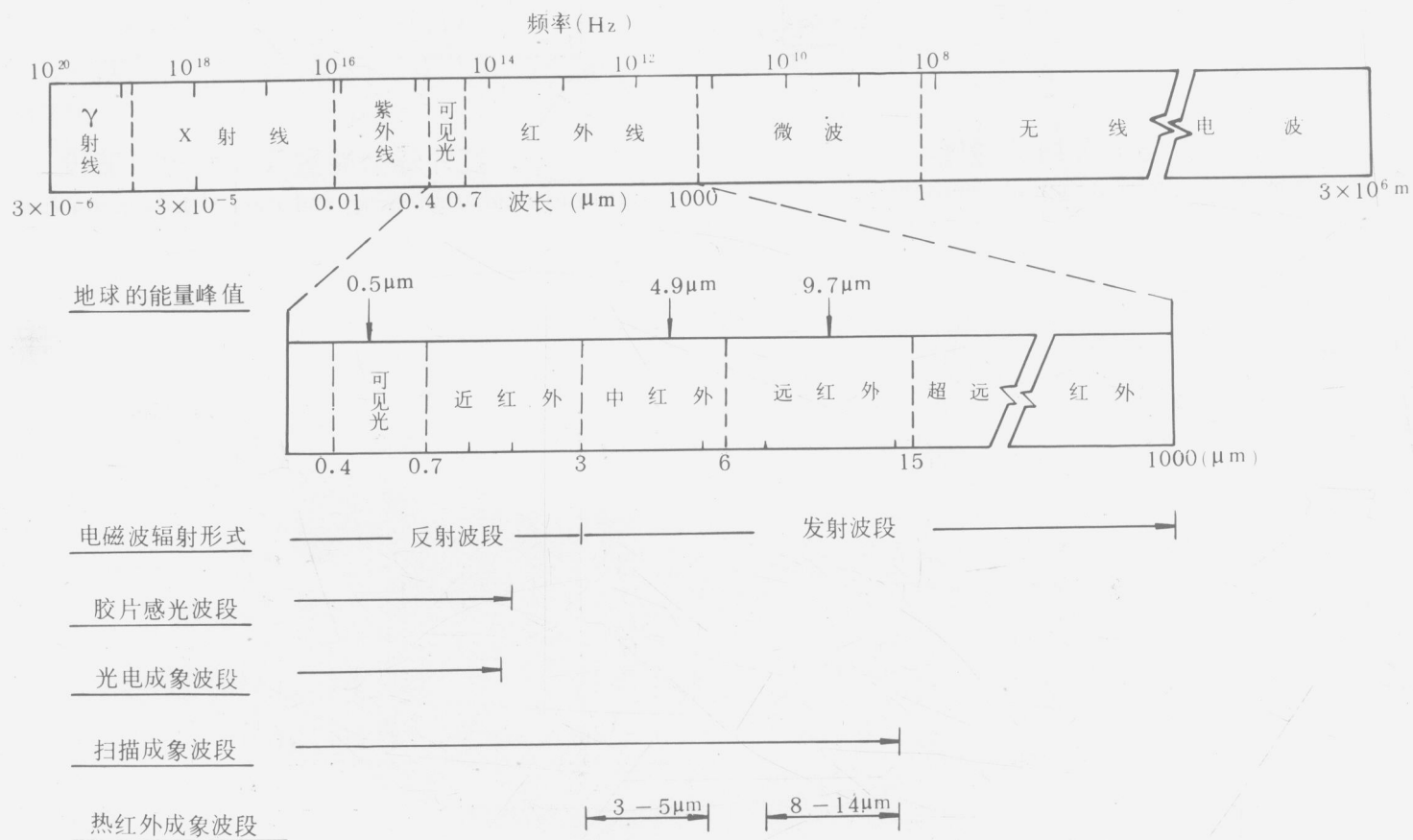
4. 室内解译：首先对热红外图象资料进行整理、编录和制作镶嵌图，然后进行室内解译，并对图象异常进行野外检查验证，建立解译标志。

5. 提交成果：通过对前人资料、热红外图象、野外测试成果及验证结果进行综合研究、分析，根据实际需要编制专业解译图件，提交成果报告。

本章通过图表形式简明地介绍热红外遥感波谱知识、使用波段、热红外成象方式与原理；用流程图表示航空热红外遥感的工作过程及其各个环节之间的关系；同时以图片形式展示运载平台、传感器、图象处理系统、红外辐射测温仪等设备，以供读者了解航空热红外遥感工作的全过程。

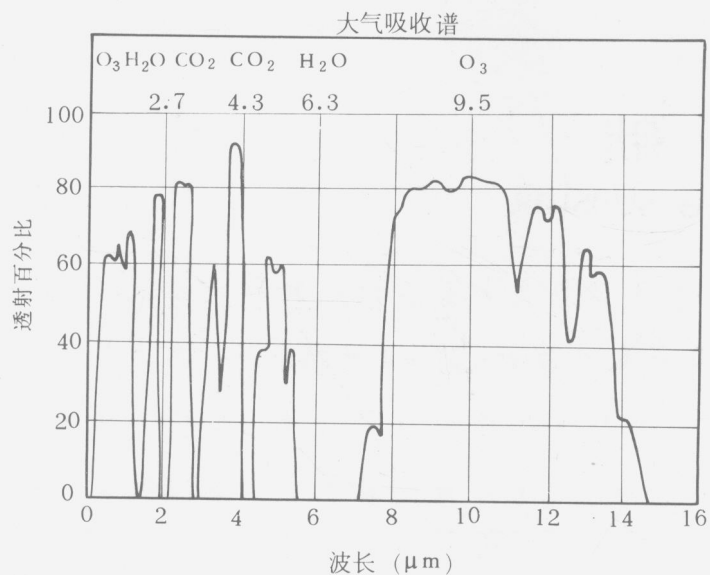
热红外遥感基础

Fundamentals of thermal infrared remote sensing



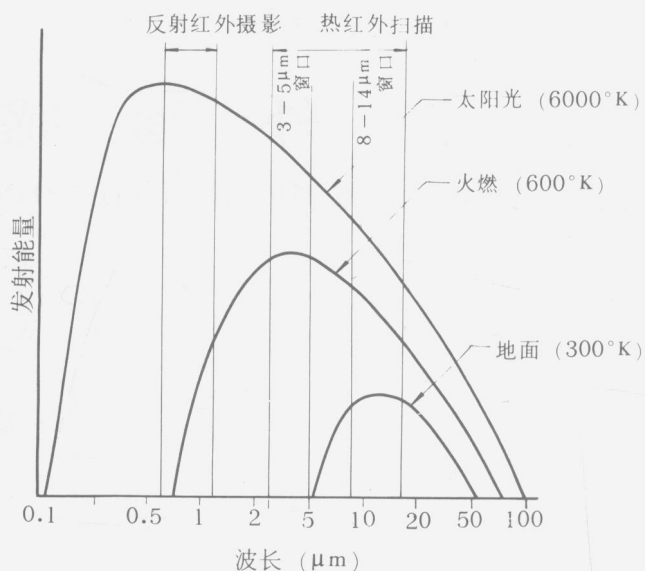
1. 电磁波谱中的红外波谱及其成像方式

(Infrared bands in electromagnetic spectrum and their imagery styles)



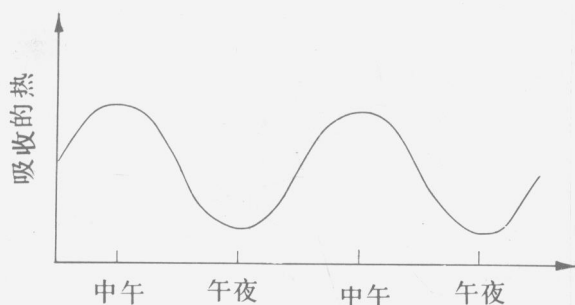
2. 大气层的透射波谱图

(Transmission spectrum map of atmosphere)

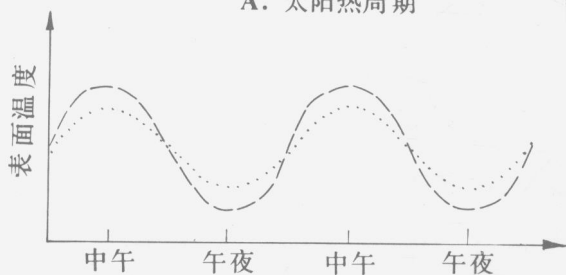


3. 红外辐射能量及大气窗口波段

(Infrared radiation energy and atmosphere window band)



A. 太阳热周期



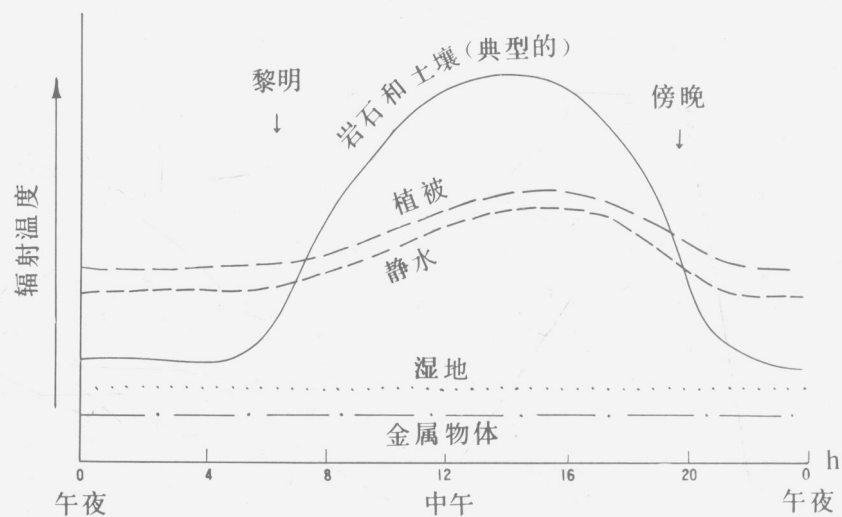
B. 表面温度的变化

-- 具有较低热惯量的物质: 页岩、火山渣

... 具有较高热惯量的物质: 砂岩、玄武岩

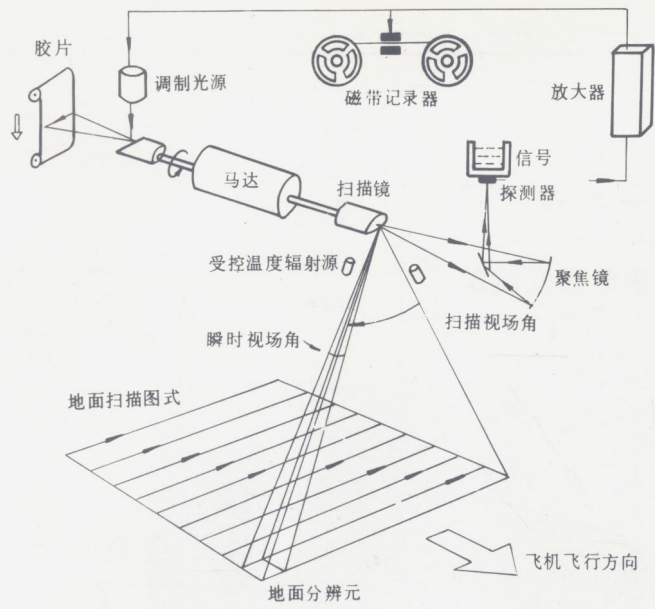
4. 太阳周日循环中不同的热惯量对表面温度的影响

(Affect of different thermal inertia to surface temperature during diurnal circulation of the sun)

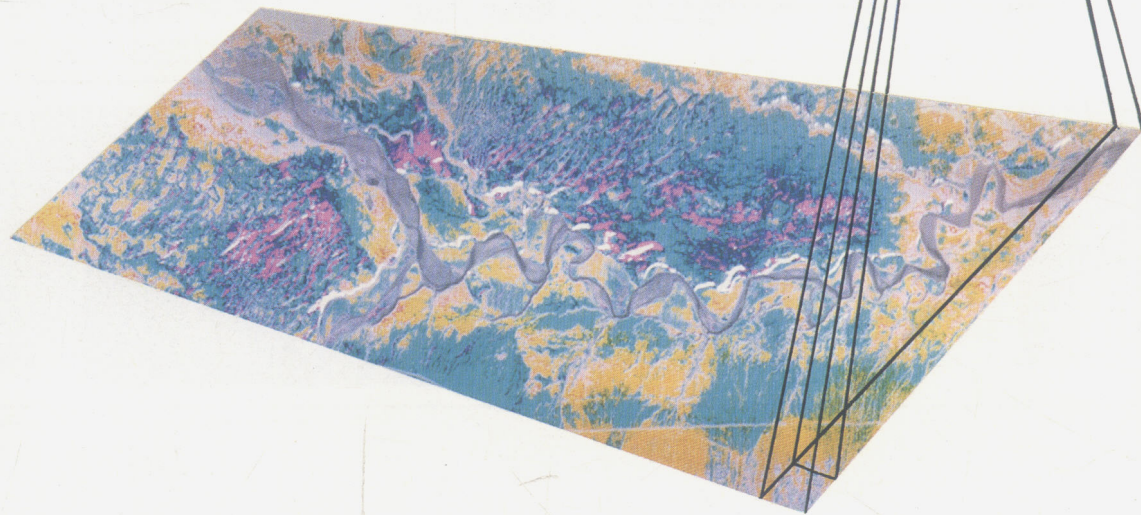


5. 典型物质的周日辐射温度曲线

(Radiation temperature curves of typical materials in diurnal period)



航空红外扫描成像系统原理图



6. 航空热红外扫描成像示意图

(Sketch map of airborne thermal infrared scanning imagery)

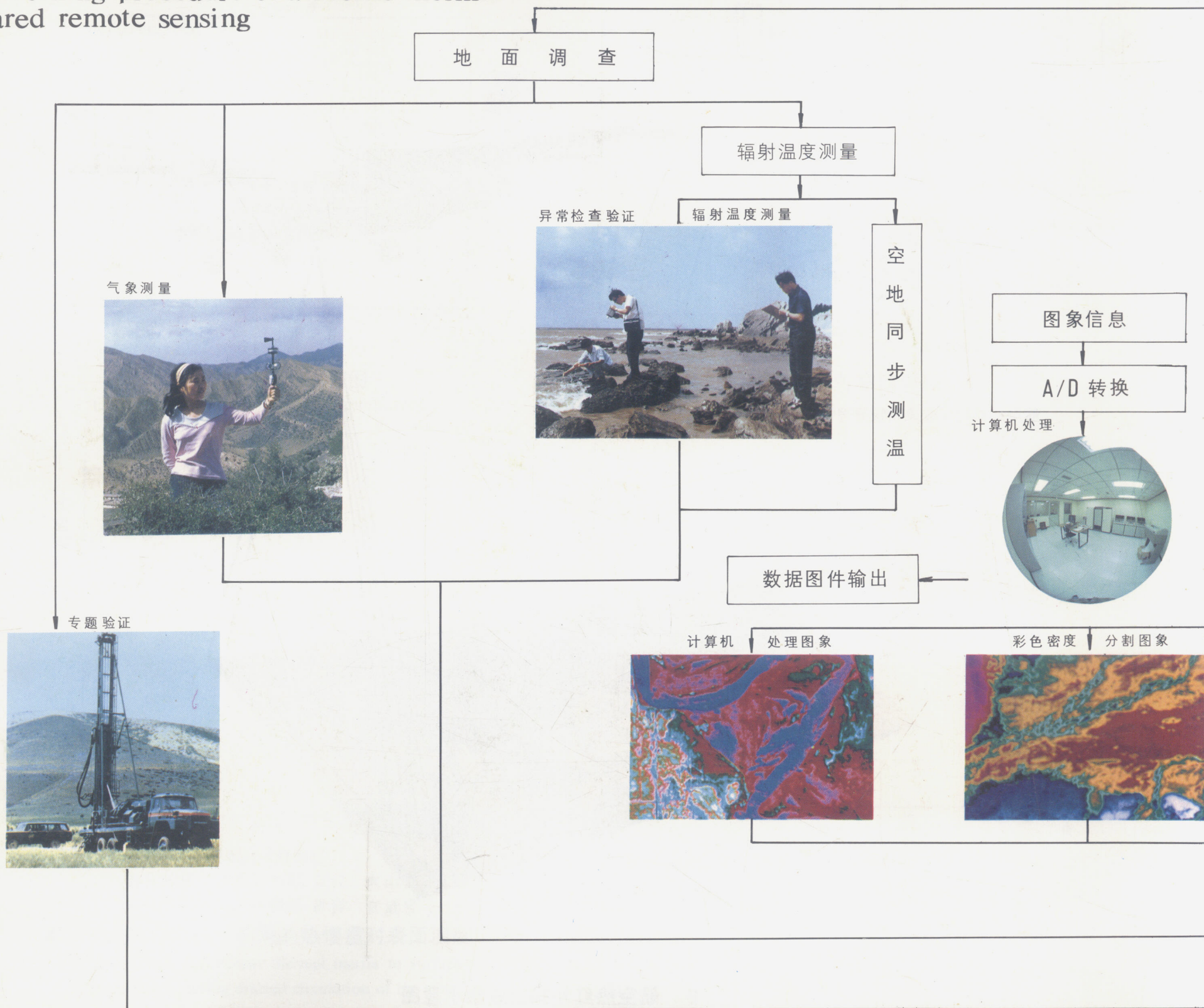
航空热红外遥感工作过程

The working procedure of airborne thermal infrared remote sensing

资料搜集

计划

测区选定



7. 航空热红外遥感调查工作过程

(The working procedure of airborne thermal infrared remote sensing investigation)

前人资料

空中成象

空中同步摄影

热红外扫描成象

空中辐射温度测量

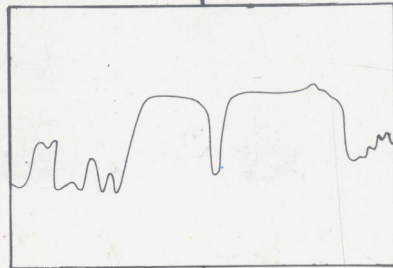
空中摄影



扫描成象

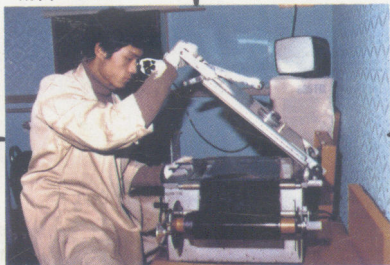


温度曲线

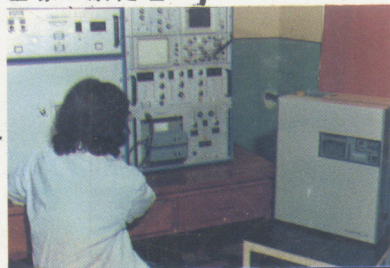


底片冲洗

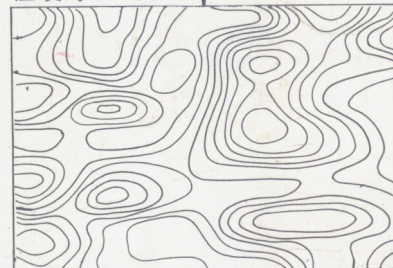
象片晒印



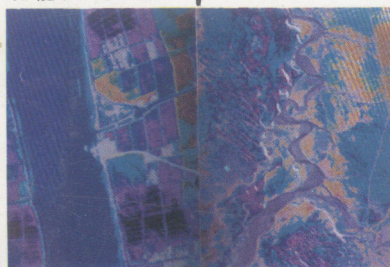
图象回放处理



温度等值线图



功能处理图象



热红外黑白

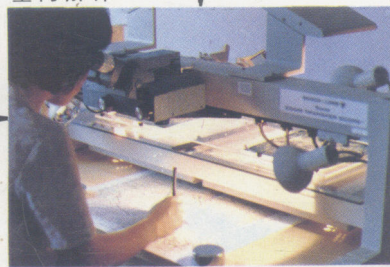
模拟图象



航空摄影图象



室内解译



综合研究分析

成果图件

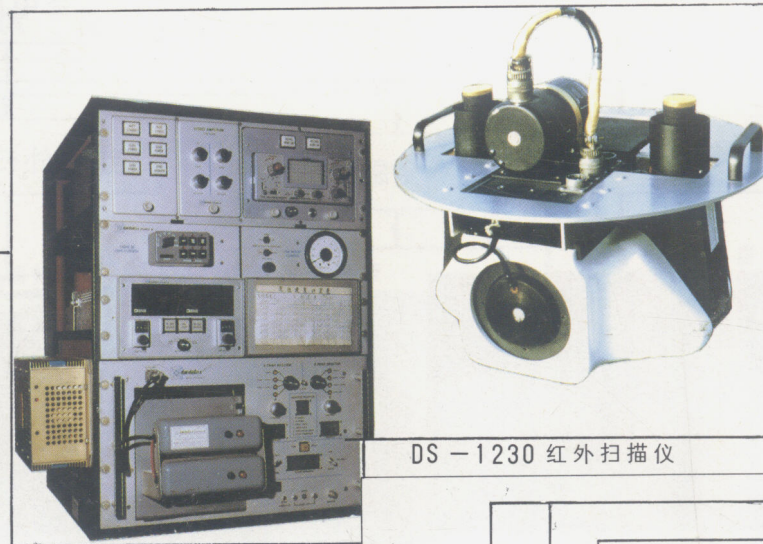
成果报告

航空遥感飞机

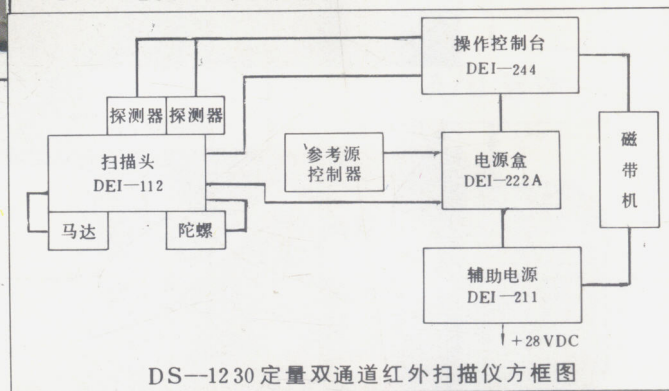


双水獭飞机

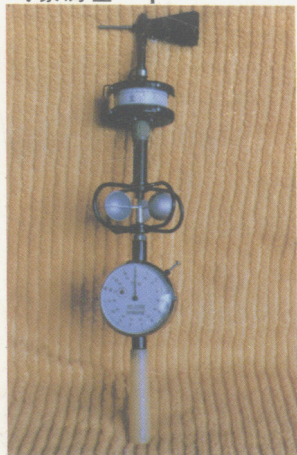
空中扫描成像



DS-1230 红外扫描仪



气象测量

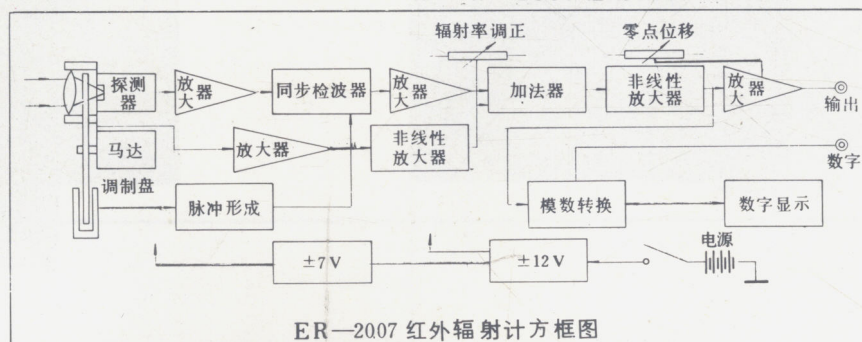


风速计



辐射温度测量

ER-2007 辐射温度计



数据

