HRSC Anaglyphs

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Basic Information on HRSC Data

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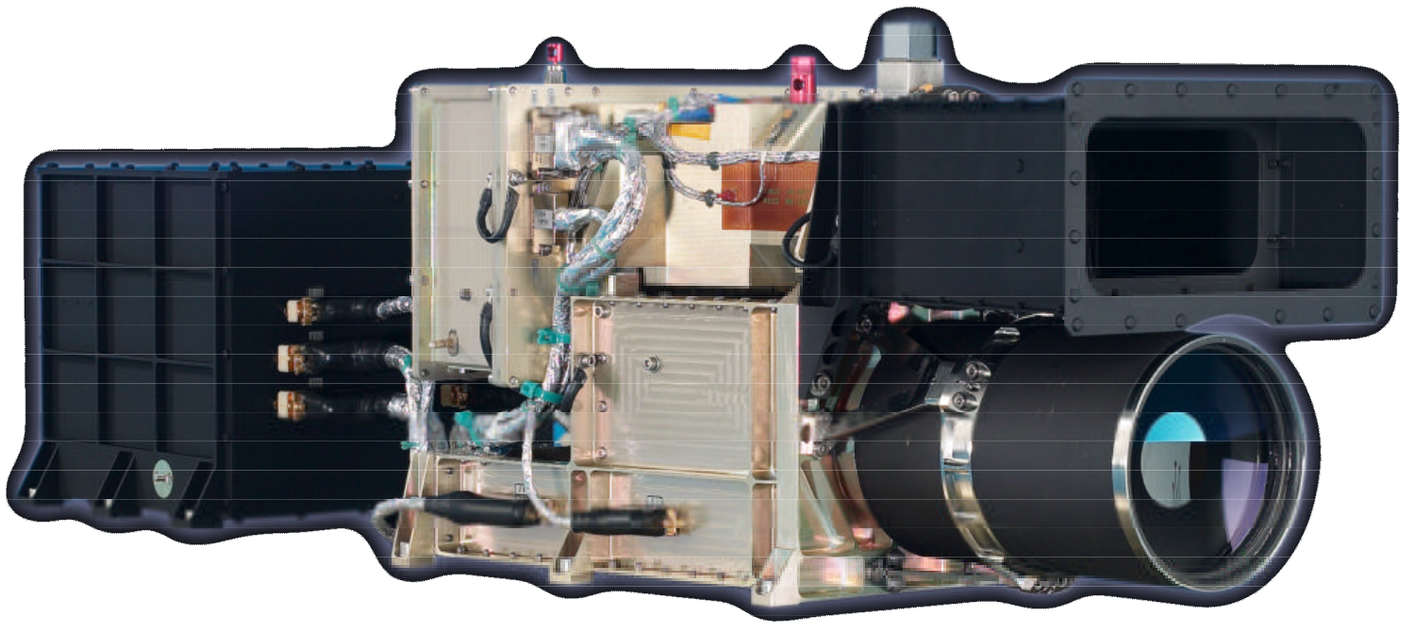
High Resolution Stereo Camera



HRSC:
Focal length 175 mm

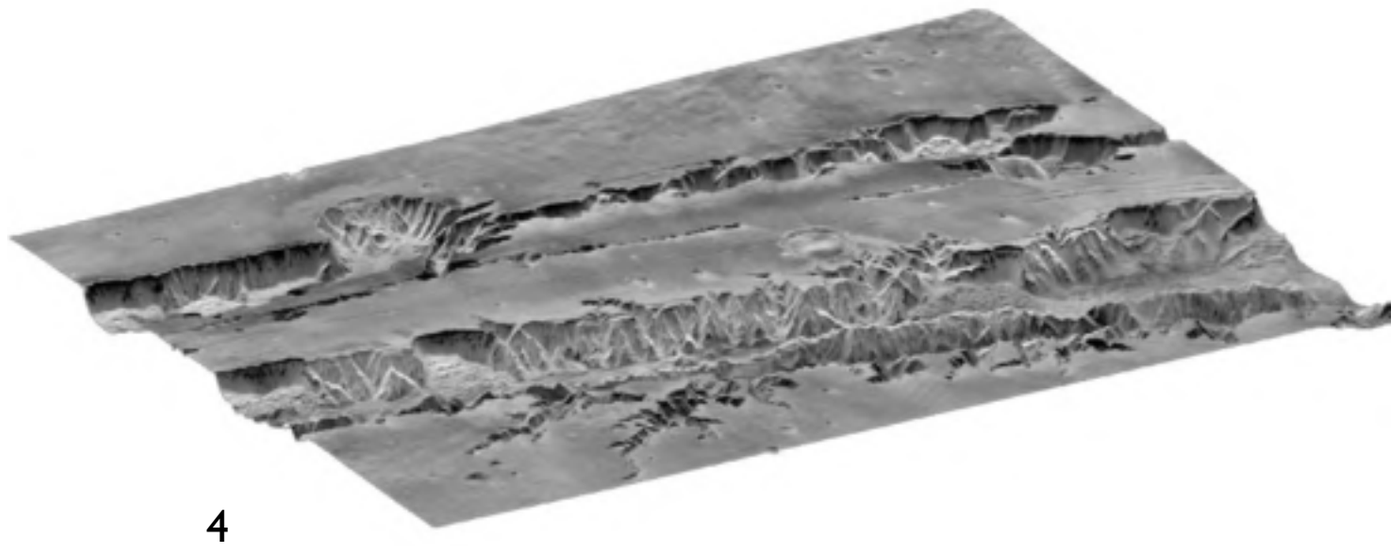
SRC:
Focal length 975 mm

Extensive information on the HRSC instrument is available on the ESA-SP 1240 article on HRSC:

http://sci.esa.int/science-e/www/object/index.cfm?fobjectid=34967

HRSC stereo

HRSC stereo
imaging principle



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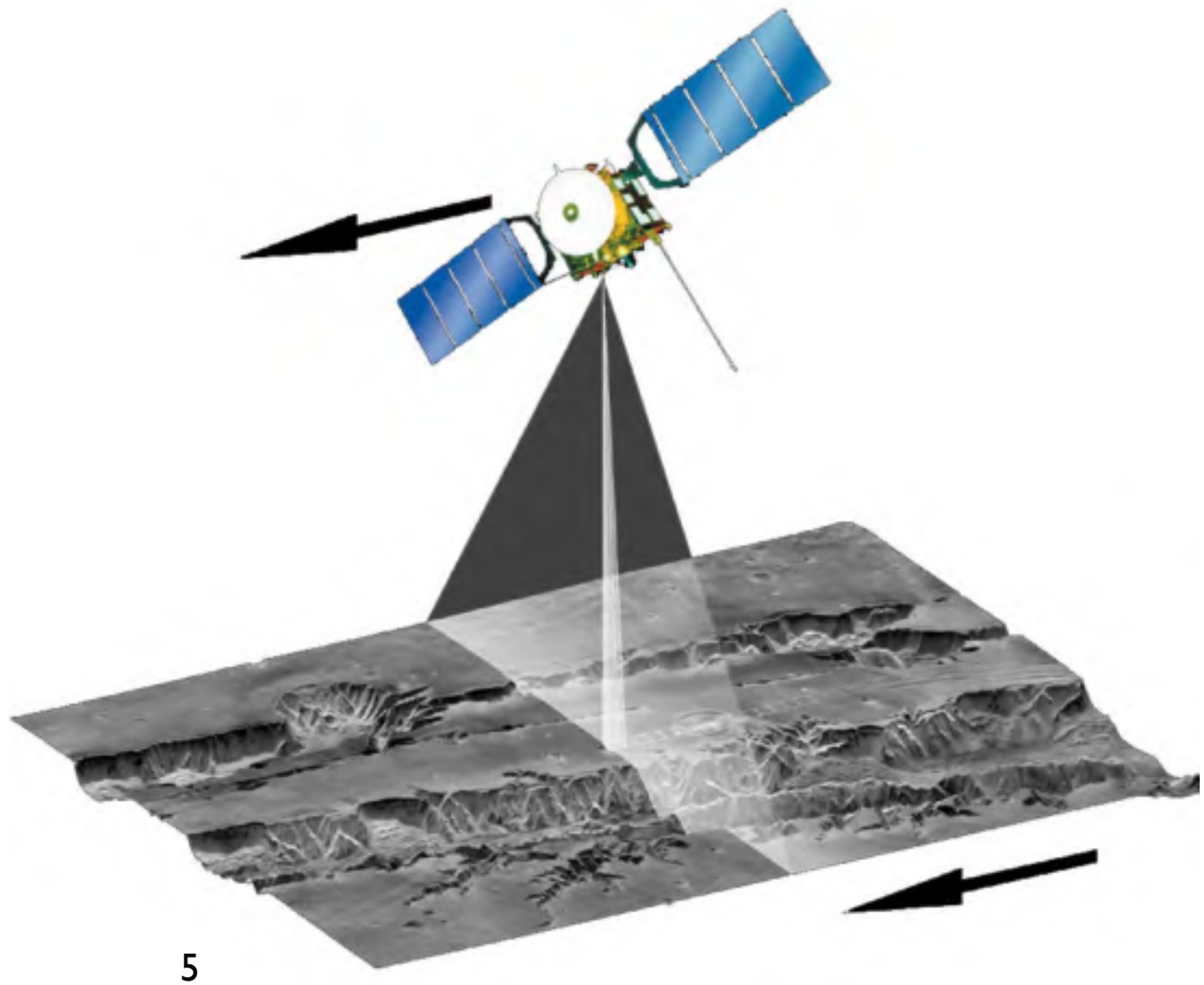
HRSC stereo

HRSC stereo
imaging principle



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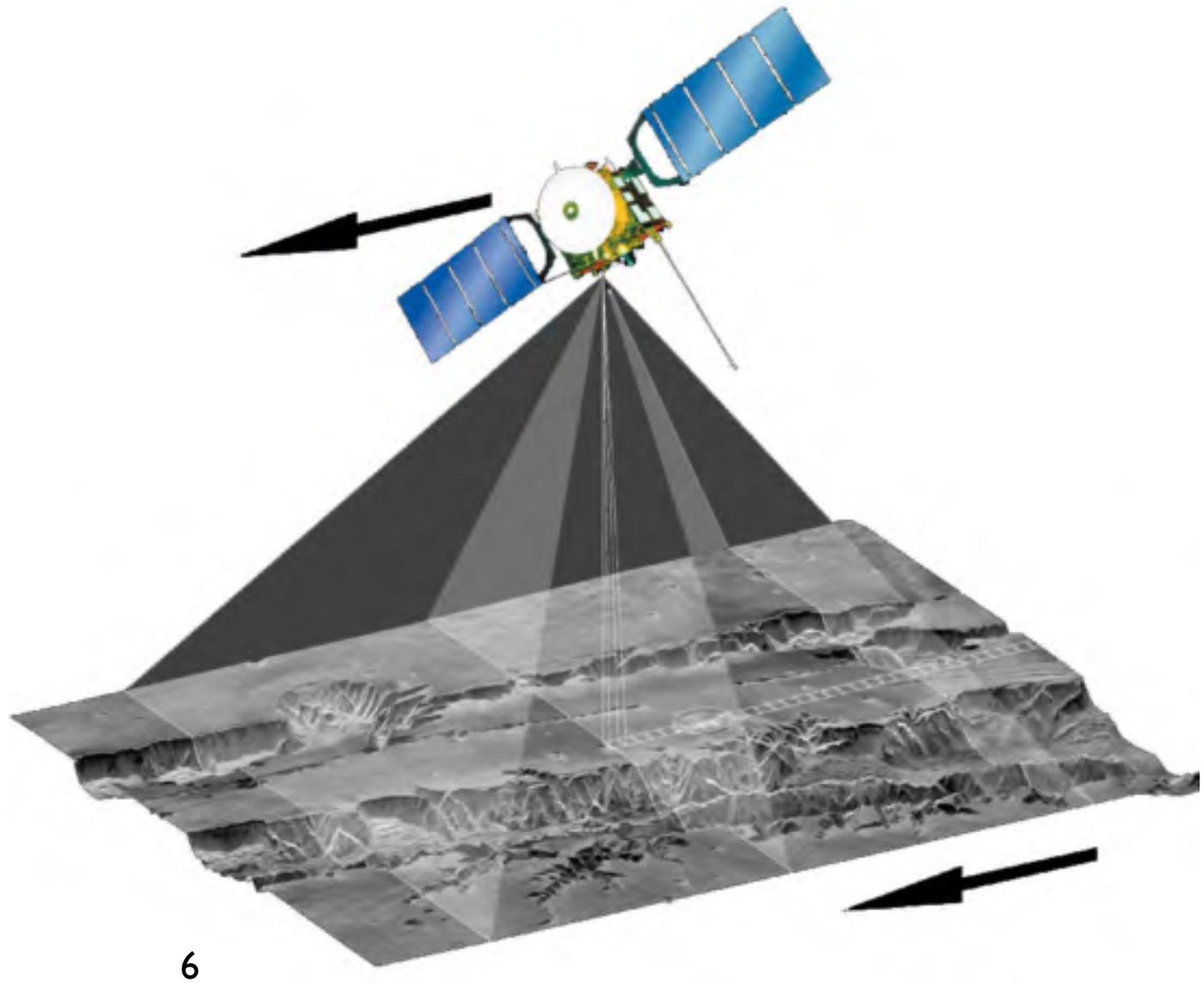
HRSC stereo

HRSC stereo
imaging principle



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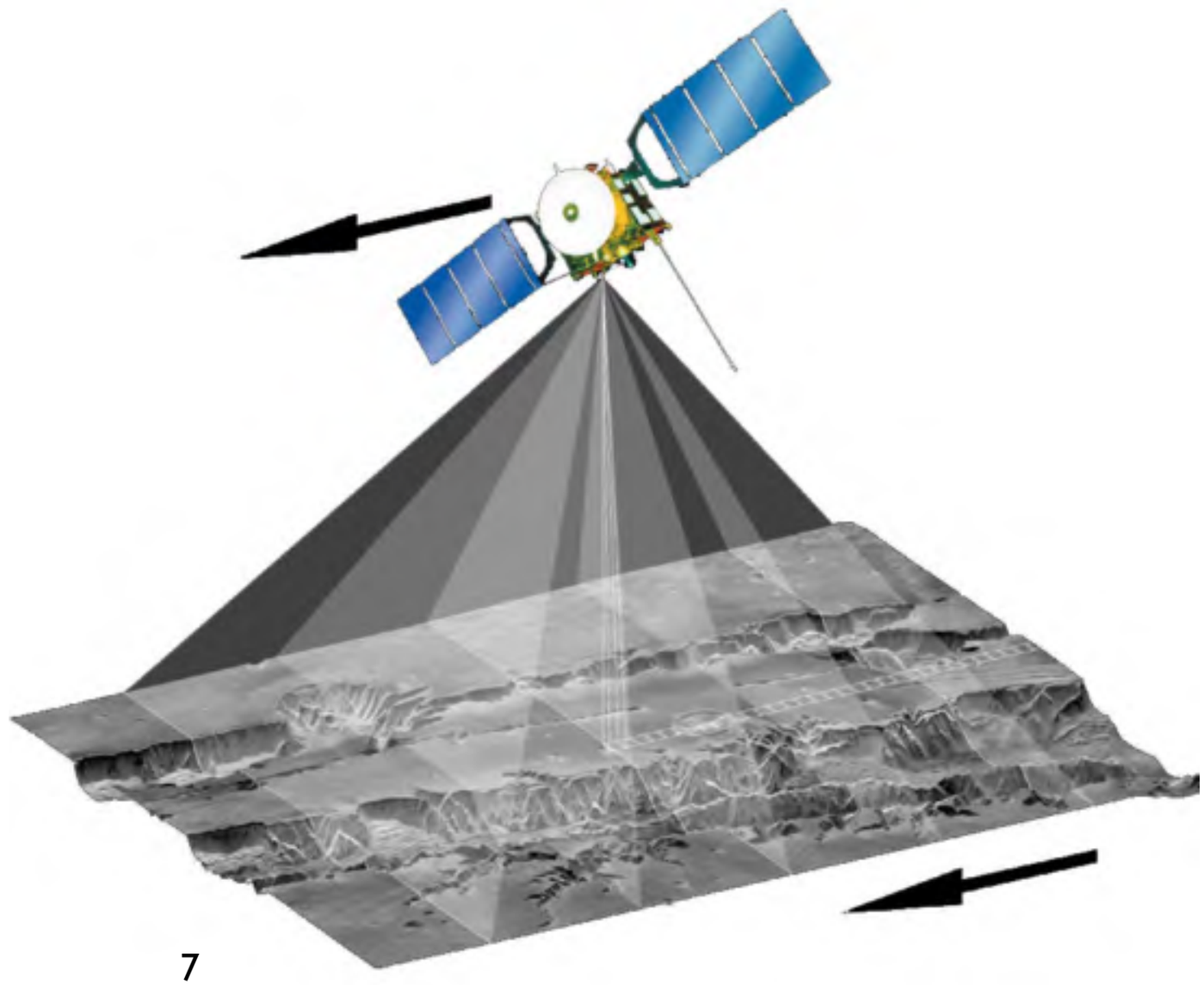
HRSC stereo

HRSC stereo
imaging principle



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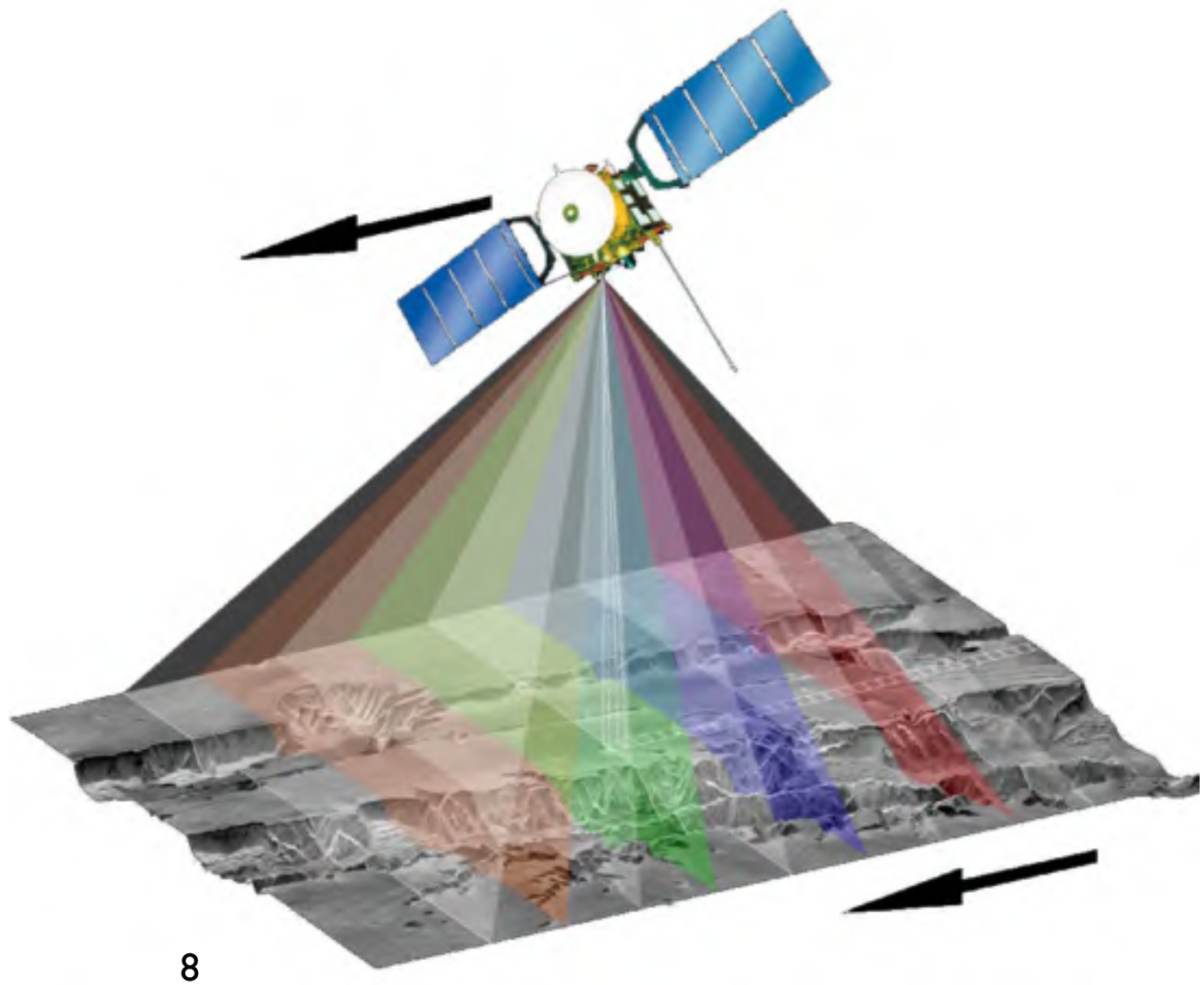
HRSC stereo

HRSC stereo
imaging principle



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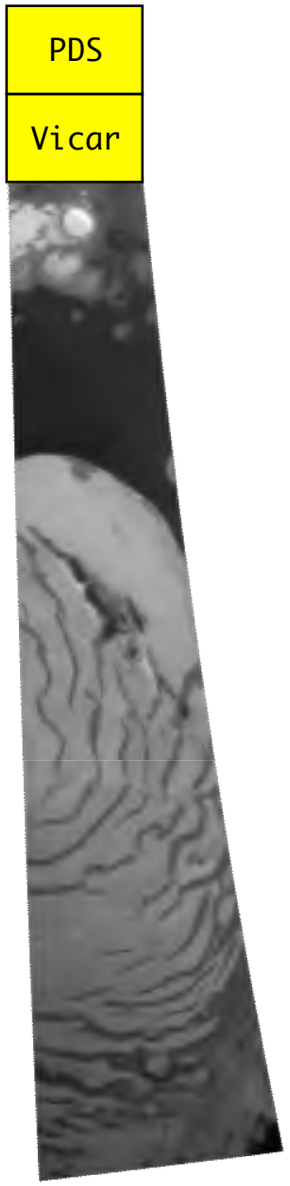
HRSC PDS & Vicar labels

label(s) →

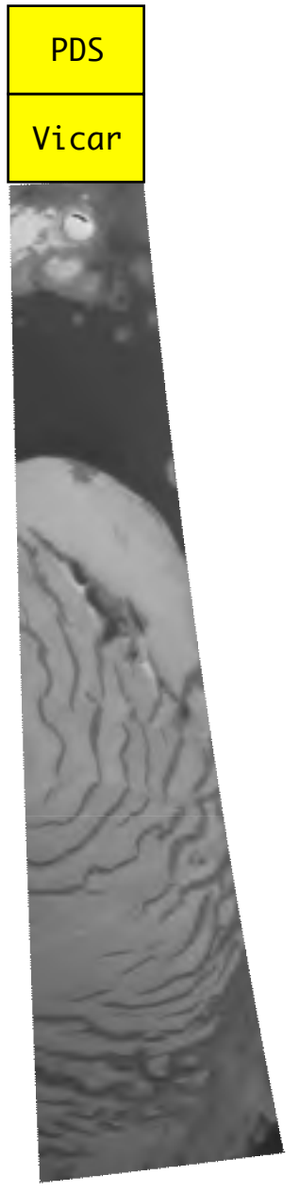
image →

processing level →

Level2

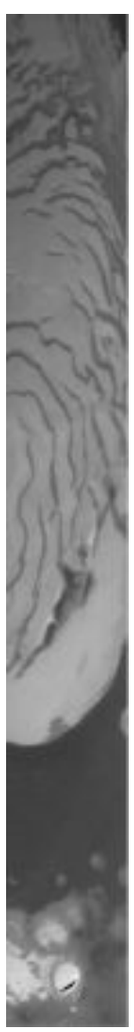


Level3



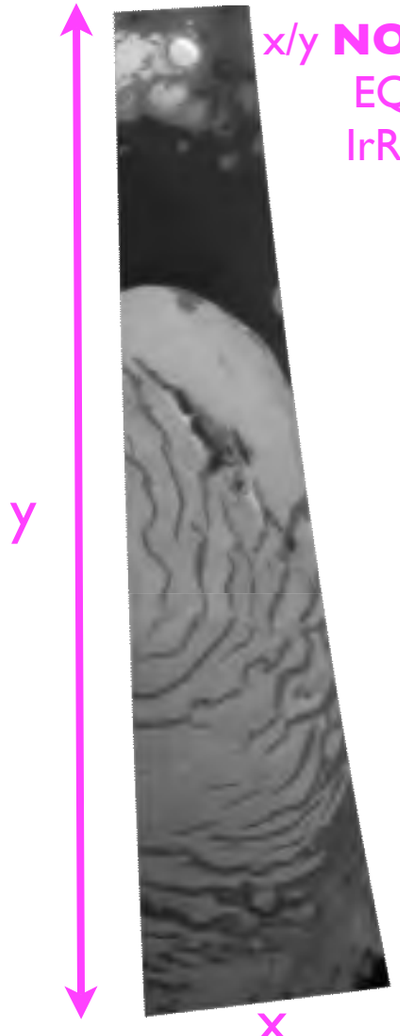
Level4

What to do with Levels



Level2

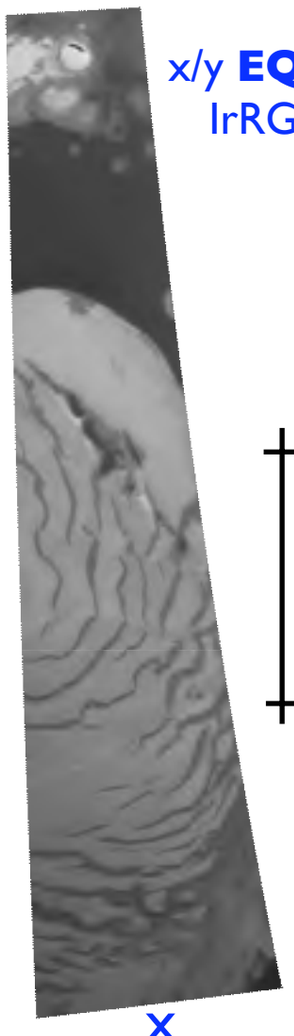
- **anaglyphs** ✓
- Subset & choose projection ✓
- *Create* DTMs X



x/y **NOT** necessarily EQUAL for IrRGB - ND

Level3

- Single band display ✓
- RGB display ✓



x/y **EQUAL** for IrRGB - ND

Level4

- Single band display ✓
- RGB/pan-sharp display ✓
- *Use* DTMs ✓
- Mosaics ✓

Done at the workshop ✓

NOT done at the workshop X

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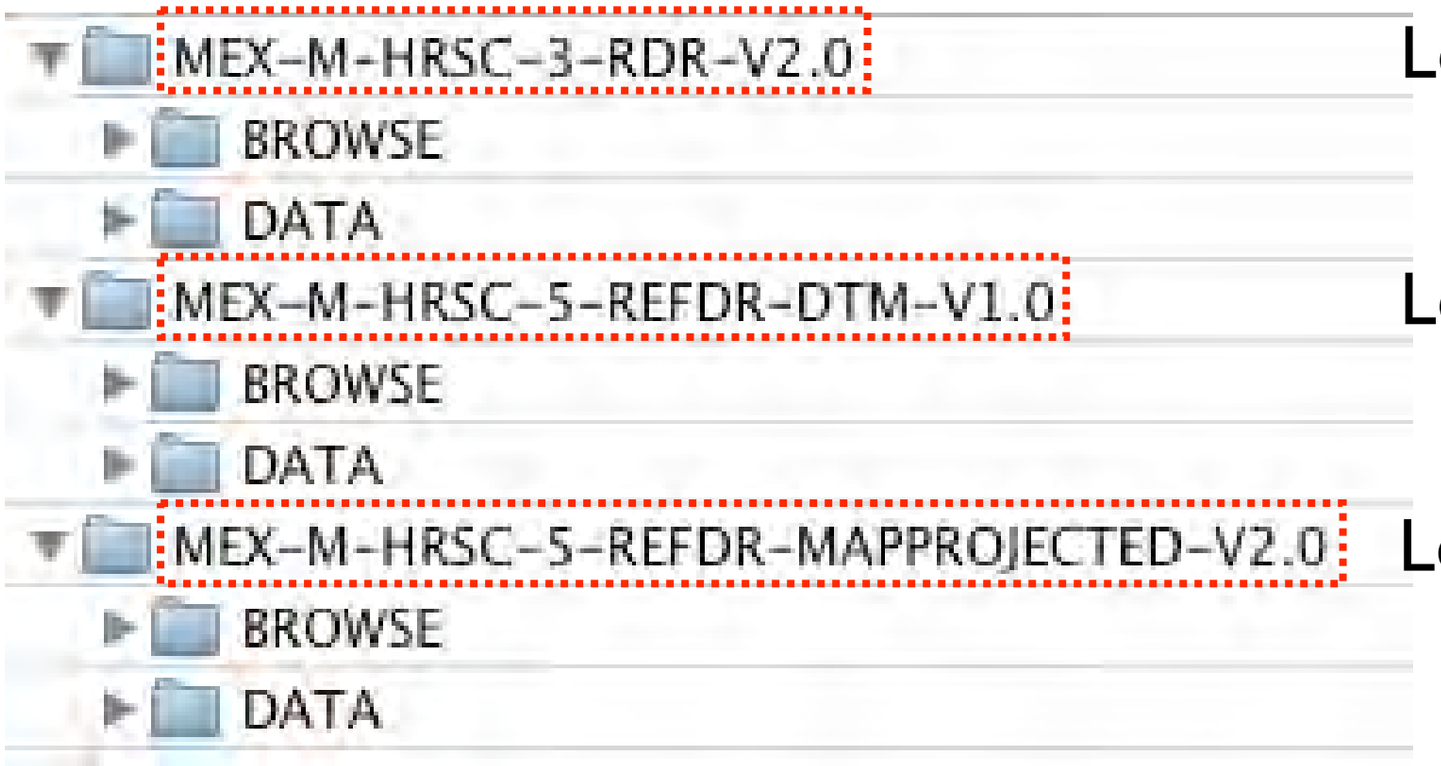
HRSC Level 2,3,4



Level2

Level4

Level3

File naming conventions

The following structure of filenames will be used:

Hoooo_mmmm_DDl.IMG

- camera id H
- orbit number oooo
- image number in one orbit mmmm
- detector id dd

(can be nd, s1, s2, p1, p2, re,ir, gr, bl, 10, 11, sr)

- level (0,1,2,3) l

-example: H1234_0023_ND2.IMG

(small letters on the PDS!)

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HRSC - band names

```
H0000_0000_ND2.IMG      ND = nadir
H0000_0000_S12.IMG      S1 = stereo1
H0000_0000_S22.IMG      S2 = stereo2
```

processing level
(Level2)

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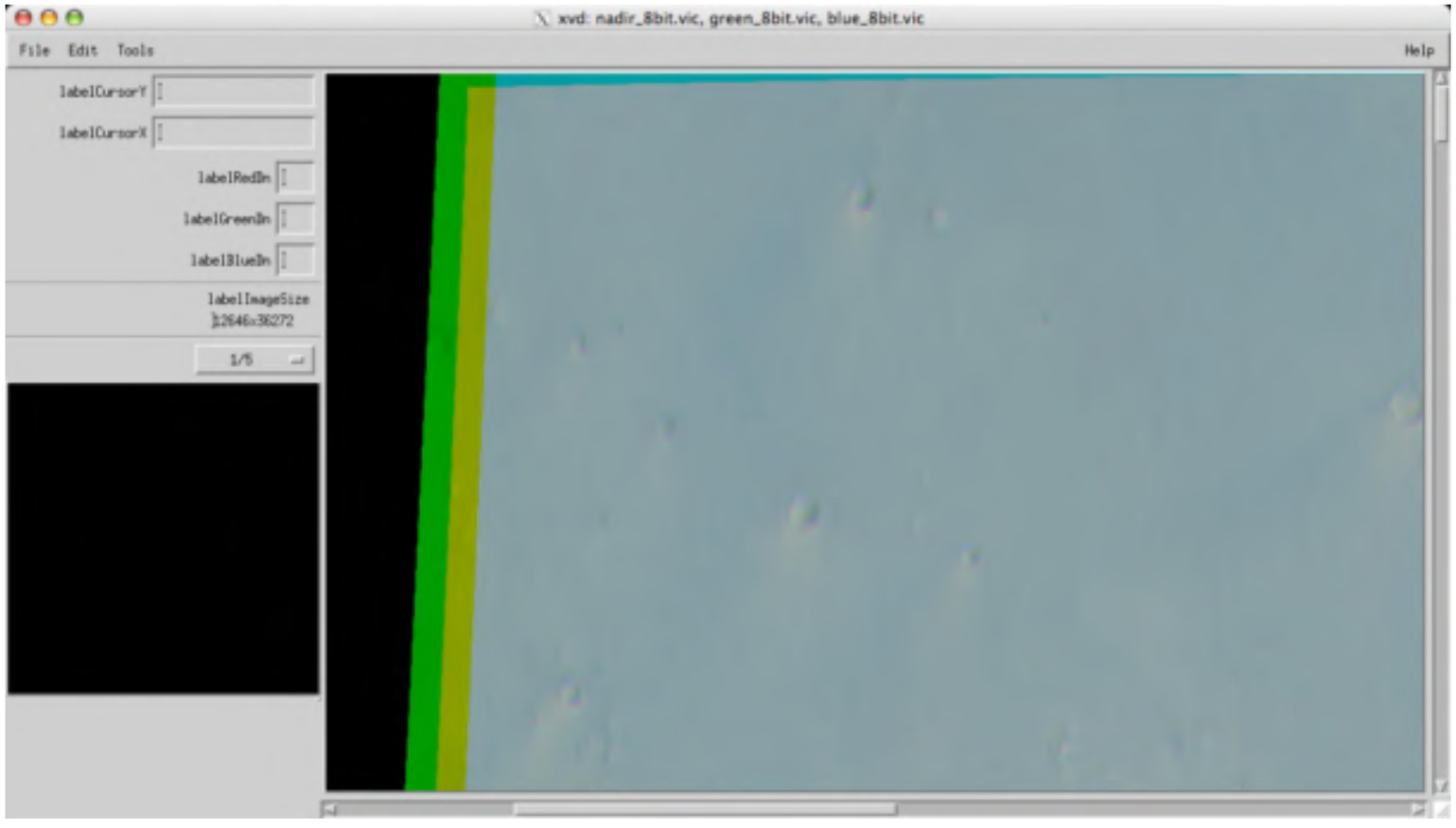
XVD (image viewer)

"xvd" is an image viewer for HRSC data (part of the "miniVICAR" package, see below)



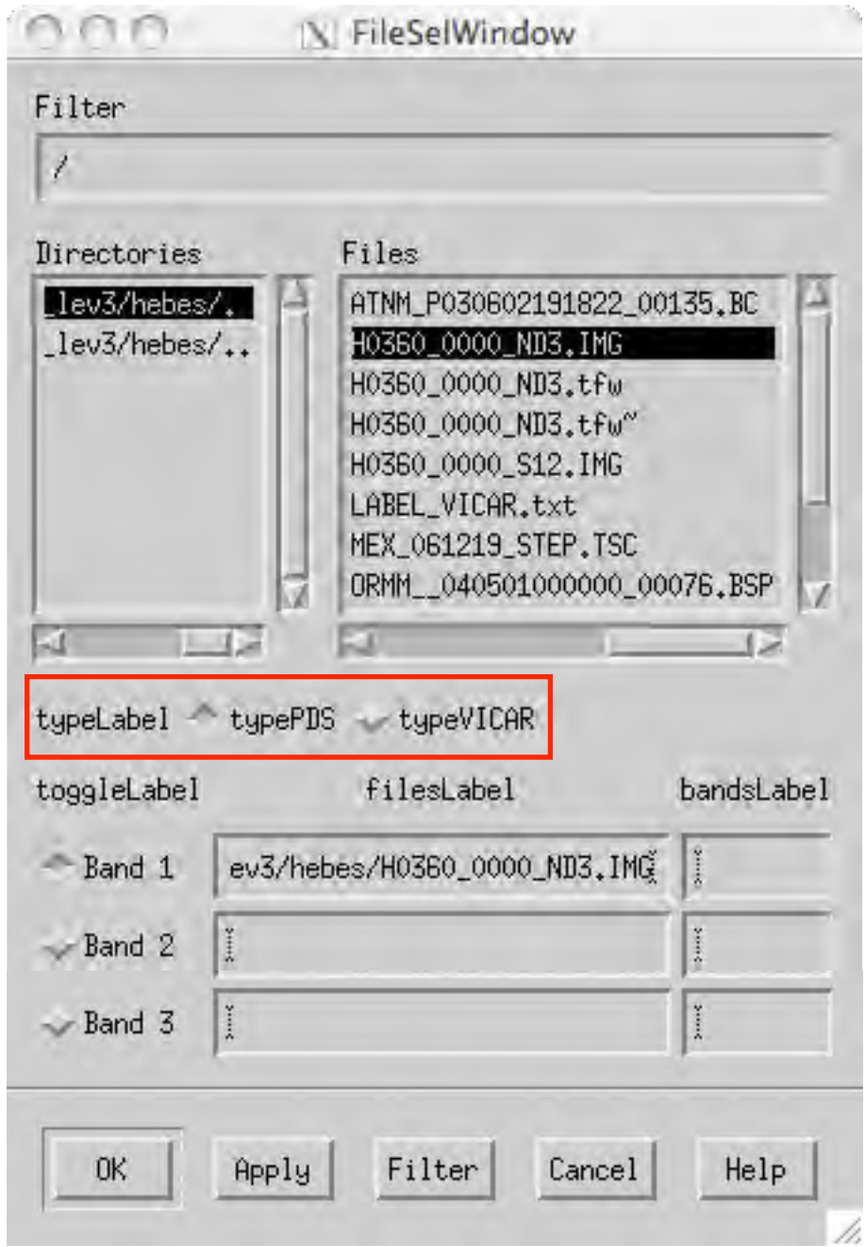
SOURCE CODE:

ftp://psa.esac.esa.int/pub/mirror/MARS-EXPRESS/HRSC/MEX-M-HRSC-3-RDR-V2.0/SOFTWARE

LINUX x86 BINARY (provided here, also on DVD)

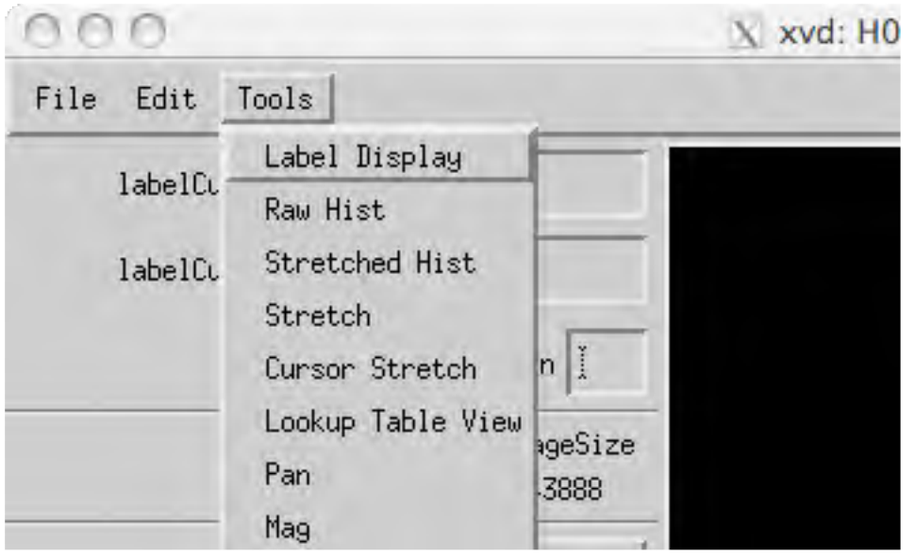
ftp://gorilla.estec.esa.int/pub/projects/workshop/04_MEX_DW_june_2007/software_data/minivicar/

Viewing labels



a) choose label opening the file

Both PDS and VICAR
labels can be viewed in xvd



b) view the label from xvd

Viewing labels

PDS

```
 PDS_VERSION_ID  =  PDS3

/* FILE DATA ELEMENTS */

   RECORD_TYPE  =  FIXED_LENGTH
   RECORD_BYTES  =  10383
   FILE_RECORDS  =  43891
   LABEL_RECORDS  =  2

/* POINTERS TO DATA OBJECTS */

   ^IMAGE_HEADER  =  3
   ^IMAGE  =  4

/* IDENTIFICATION DATA ELEMENTS */

   FILE_NAME  =  "H0360_0000_ND3.IMG"
   DATA_SET_ID  =  "MEX-M-HRSC-5-REFDR-MAPPROJECTED-V2.0"
   DETECTOR_ID  =  MEX_HRSC_NADIR
   EVENT_TYPE  =  "MARS-GLOBAL-MAPPING-Te-Fl-Lc"
   INSTRUMENT_HOST_ID  =  MEX
   INSTRUMENT_HOST_NAME  =  "MARS EXPRESS"
   INSTRUMENT_ID  =  HRSC
   INSTRUMENT_NAME  =  "HIGH RESOLUTION STEREO CAMERA"
   MISSION_NAME  =  "MARS EXPRESS"
   MISSION_PHASE_NAME  =  MC_Phase_6
   PROCESSING_LEVEL_ID  =  3
   PRODUCT_CREATION_TIME  =  2006-07-28T17:46:42.000Z
   PRODUCT_ID  =  "H0360_0000_ND3.IMG"
   RELEASE_ID  =  0006
   REVISION_ID  =  0000
....
....
....
```

VICAR

```
************************************************************
     +++++ System Label of file H0360_0000_ND3.IMG +++++
           3 dimensional IMAGE file
           File organization is BSQ
           Pixels are in BYTE format from a JAVA host
           1 bands
           43888 lines per band
           10383 samples per line
           0 lines of binary header of type
           0 bytes of binary prefix per line

************************************************************

************************************************************
      +++++ Property Label of file H0360_0000_ND3.IMG +++++

     -------------------------------------------

  PROPERTY = 'M94_ORBIT'

    ORBIT_NUMBER=360
    ASCENDING_NODE_LONGITUDE=221.55
    ORBITAL_ECCENTRICITY=0.606
    ORBITAL_INCLINATION=86.56
    PERIAPSIS_ARGUMENT_ANGLE=298.62
    PERIAPSIS_TIME='2004-05-02T21:06:37.000Z'
    PERIAPSIS_ALTITUDE=266.17
    ORBITAL_SEMIMAJOR_AXIS=9261.67
    SPACECRAFT_SOLAR_DISTANCE=2.42487e+08
    SPACECRAFT_CLOCK_START_COUNT='1/0031612651.56187'
    SPACECRAFT_CLOCK_STOP_COUNT='1/0031613373.19695'
    START_TIME='2004-05-02T21:18:50.969Z'
    STOP_TIME='2004-05-02T21:25:19.970Z'
    SPACECRAFT_POINTING_MODE='NADIR'
     ....
     ....
     ....
```

Anaglyphs:

Basics

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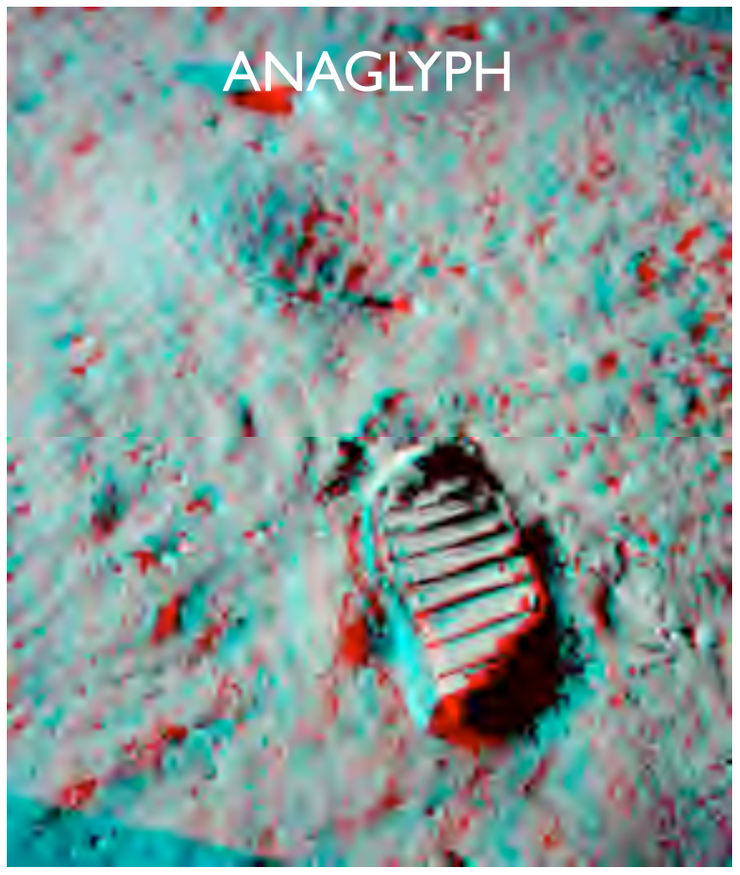
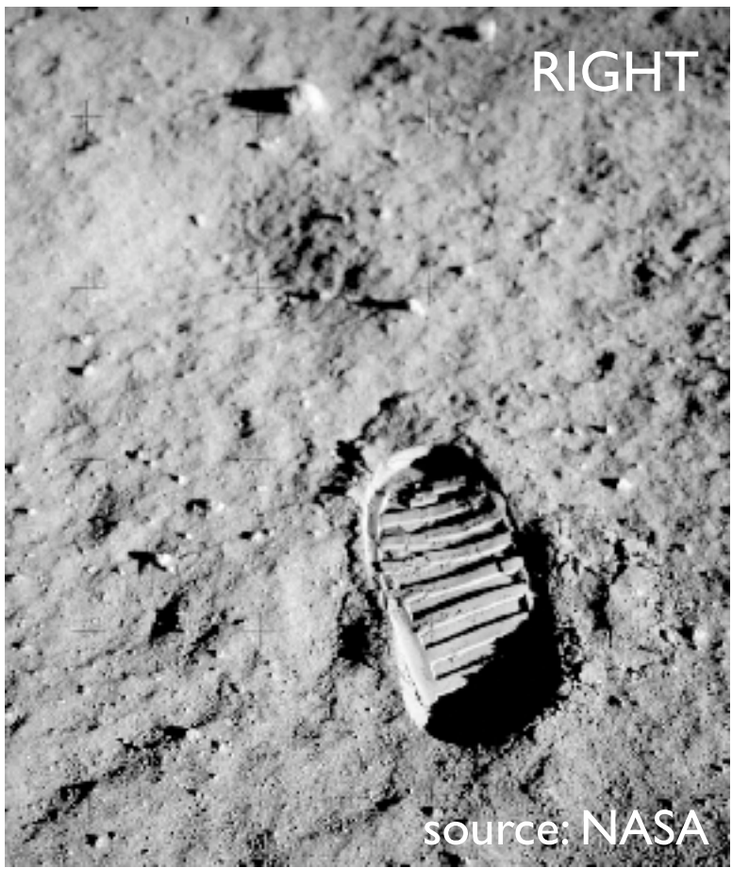
Anaglyphs: what are they?

A stereoscopic picture where the two images superimposed and printed or viewed in different colors (e.g. red, green) producing a stereo effect when viewed through corresponding color filters





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L R

Needed SPICE kernels

NEEDED SPICE

Needed spice kernels for minivicar Level2 processing:

- IK, FK, PCK, SCLK

  latest version

- SPK and CK :

  - Check START_TIME in image label

  - select corresponding Kernel

Environmental variables

```
#!/bin/tcsh

# MINIVICAR VARIABLES
setenv V2TOP /<PATH>/minivicar/vicar
source $V2TOP/vicset1.csh
source $V2TOP/vicset2.csh
setenv M94GEOCAL $V2TOP/../GEOCAL
set PATH ($V2TOP $PATH)

# VARIABLES FOR KERNELS AND DATA
setenv LEAPSECONDS $V2TOP/../kernels/NAIF0008.TLS
setenv CONSTANTS $V2TOP/../kernels/PCK00008.TPC
setenv SUNKER $V2TOP/../kernels/DE405S.BSP
setenv HWSPICE_TF $V2TOP/../kernels/MEX_V08.TF
setenv HWSPICE_TI $V2TOP/../kernels/MEX_HRSC_V03.TI
setenv HWSPICE_TSC $V2TOP/../kernels/MEX_070321_STEP.TSC
setenv HWSPICE_BC ./ATNM_P030602191822_00135.BC
setenv HWSPICE_BSP ./ORMM__050301000000_00117.BSP
```

"minivicar_env.sh" does the job FOR THE WORKSHOP
BUT ATTENTION SHOULD BE PAID!!!

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The tools to use:

“hrortho”

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hrortho

Syntax:

```
$HWLIB/hrortho inp=... ori=spice dtm=... out=... [optionals]
```

```
dtm=...      dtm-file or height above datum in meter
inp=...      Input image used if
out=...      Output image generated
ori=spice    (spice KERNELS used)
fitto=...    File to which OUT should fit.
sL_inp=...   starting lines of input Level2 image
nl_inp=...   no. lines starting from nl_inp to be processed
```

“hrortho” produced map projected HRSC images

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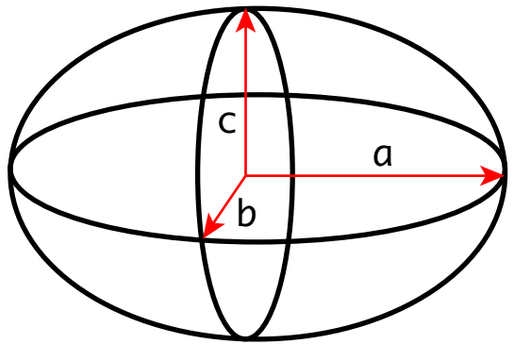
hrortho




```
mp_type=...   type of output projection
outmax=...    size limit for output image [in MegaByte]
a_axis=...    value of the a-axis of a solar system body
b_axis=...    value of the b-axis of a solar system body
c_axis=...    value of the c-axis of a solar system body
        ( DEFAULT a_axis=b_axis=3396.19 c_axis=3376.2 )
mp_scale=... measured in kilometers per pixel
cen_lat=...   reference latitude for certain map projections
cen_lon=...   reference longitude for certain map projections
```

For other parameters, have a look at:

`$V2TOP/hw/lib/x86-linux/hrortho.pdf`

(it's ASCII file, NOT an Adobe .pdf)

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hrortho - mp_type

mp_type=... type of output projection

```
parm MP_TYPE    type=(string,40) count=1   default=SINUSOIDAL +
           valid=(    ALBERS_ONE_PAR,                  +
                ALBERS_TWO_PAR,                  +
                CYLINDRICAL_E_A,                 +
                EQUIDISTANT,                           +
                LAMBERT_AZIMUTH,                 +
                LAMBERT_ONE_PAR,                 +
                LAMBERT_TWO_PAR,                 +
                MERCATOR,                        +
                MOLLWEIDE,                       +
                ORTHOGRAPHIC,                          +
                SINUSOIDAL,                            +
                STEREOGRAPHIC,                         +
                PERSPECTIVE,                           +
                RD,                        +
                UTM,                       +
                BMN28,                           +
                BMN31,                           +
                BMN34,                           +
                ING,                       +
                SLK,                       +
                GAUSS_KRUEGER,                         +
                SOLDNER,                         +
                CORRECTION )
```

copy-pasted from:

$V2TOP/hw/lib/x86-linux/hrortho.pdf

hrortho for anaglyphs

```
hrortho inp=H0572_0000_ND2.IMG out=nadir dtm=0 ori=spice

hrortho inp=H0572_0000_S12.IMG out=stereo1 dtm=0 fitto=nadir
```

stereo1	nadir	nadir

OR:

```
hrortho inp=H0572_0000_ND2.IMG out=nadir dtm=0 ori=spice

hrortho inp=H0572_0000_S22.IMG out=stereo1 dtm=0 fitto=nadir
```

stereo2	nadir	nadir

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hrortho for anaglyphs

Using a 3396.19 km radius sphere:

```
hrortho inp=H0572_0000_ND2.IMG out=nadir dtm=0 ori=spice

a_axis=3396.19 b_axis=3396.19 c_axis=3396.19
```

stereo1	nadir	nadir

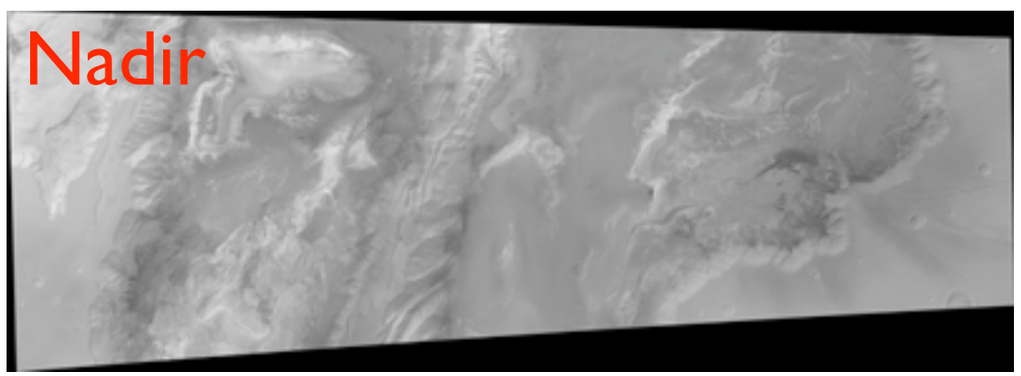
HRSC anaglyph

- Nadir on 2 channel (e.g. Green, Blue)
- Stereo1 (OR Stereo2) on the remaining channel (Red)

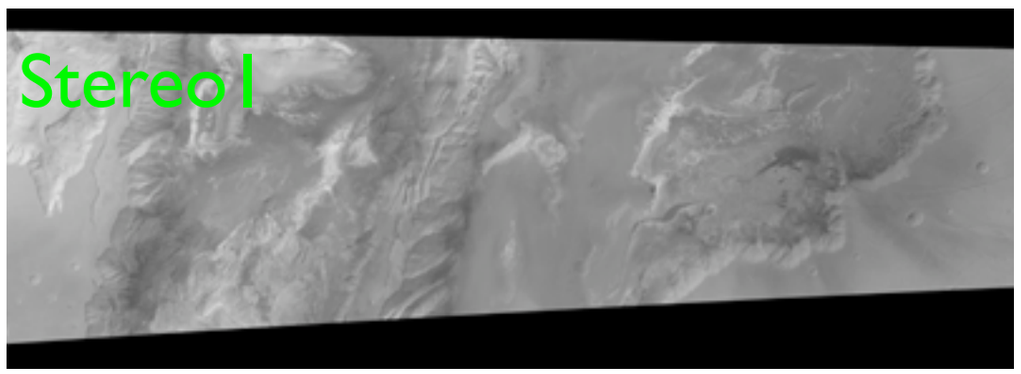
HRSC Anaglyph -How?

```
$HWLIB/hrortho inp=H0360_0000_ND2.IMG out=nadir0 sl_inp=5000 nl_inp=30000
ori=spice dtm=0
a_axis=3396.19 b_axis=3396.19 c_axis=3396.19

$HWLIB/hrortho inp=H0360_0000_S12.IMG out=red fitto=nadir0 ori=spice
a_axis=3396.19 b_axis=3396.19 c_axis=3396.19

$HWLIB/hrortho inp=H0360_0000_S22.IMG out=green fitto=nadir0 ori=spice
a_axis=3396.19 b_axis=3396.19 c_axis=3396.19
```

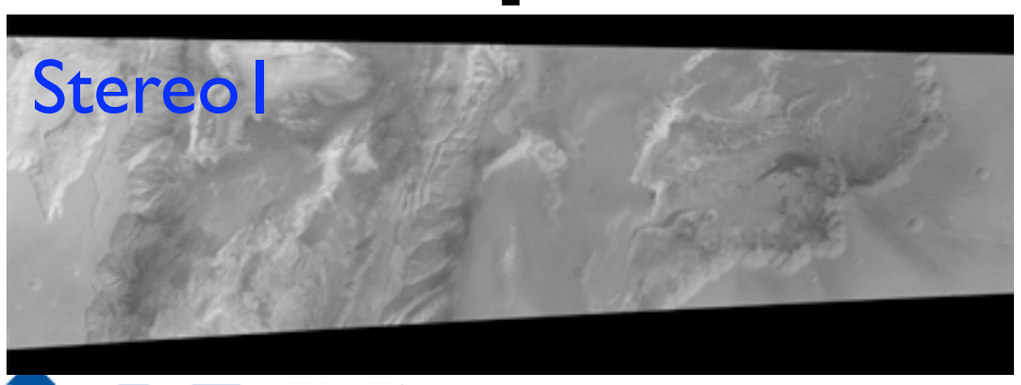
HRSC anaglyph



+



+



=

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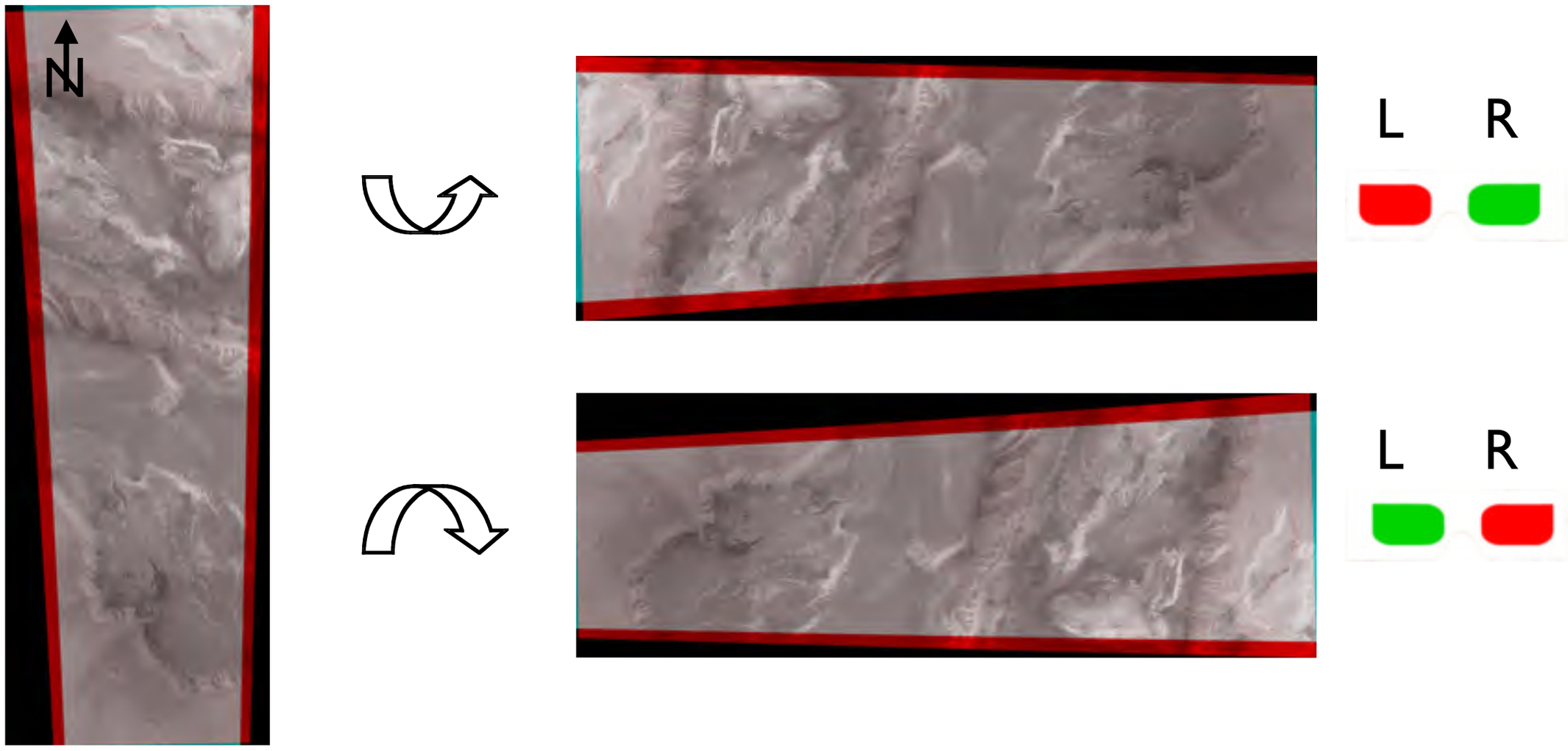
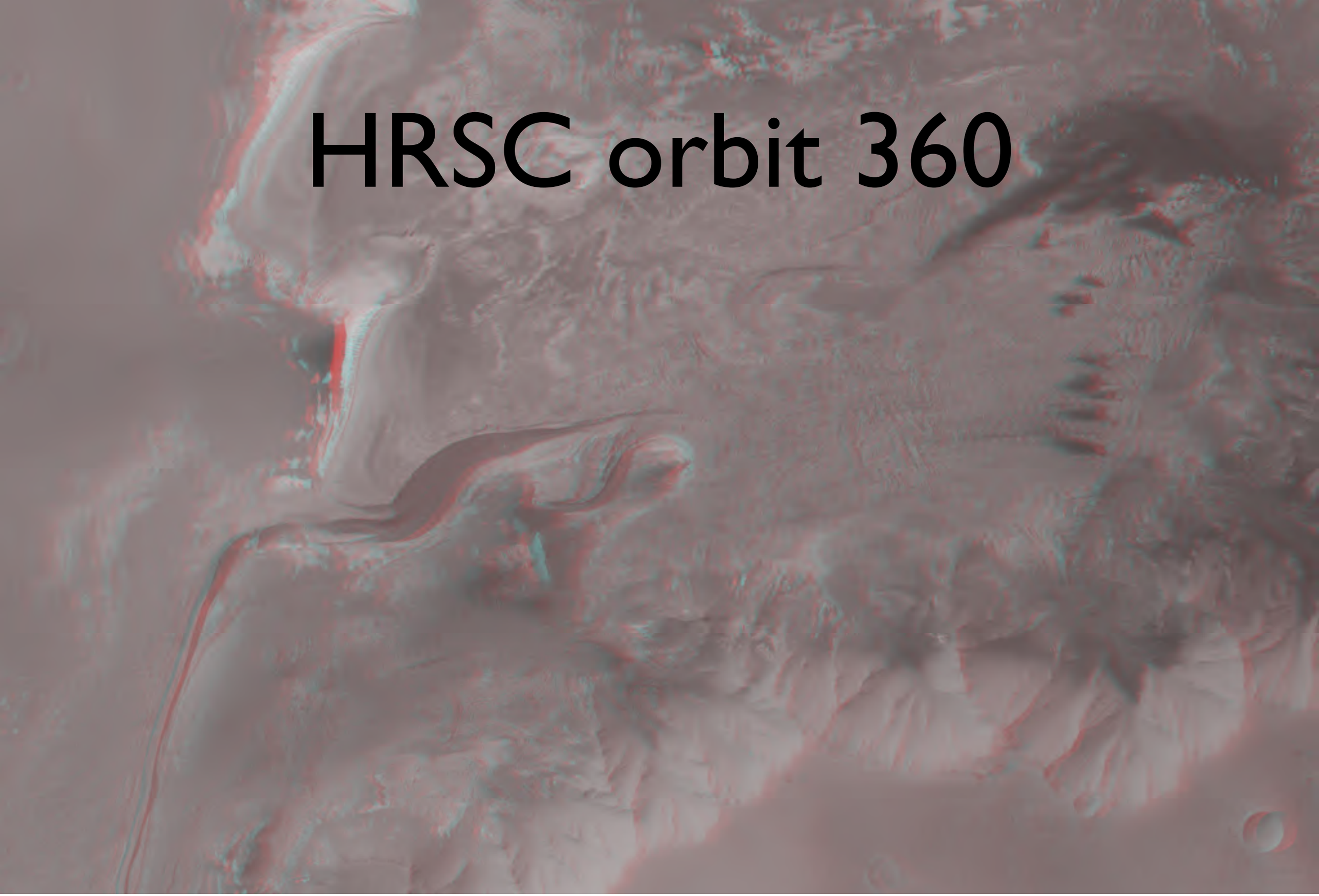
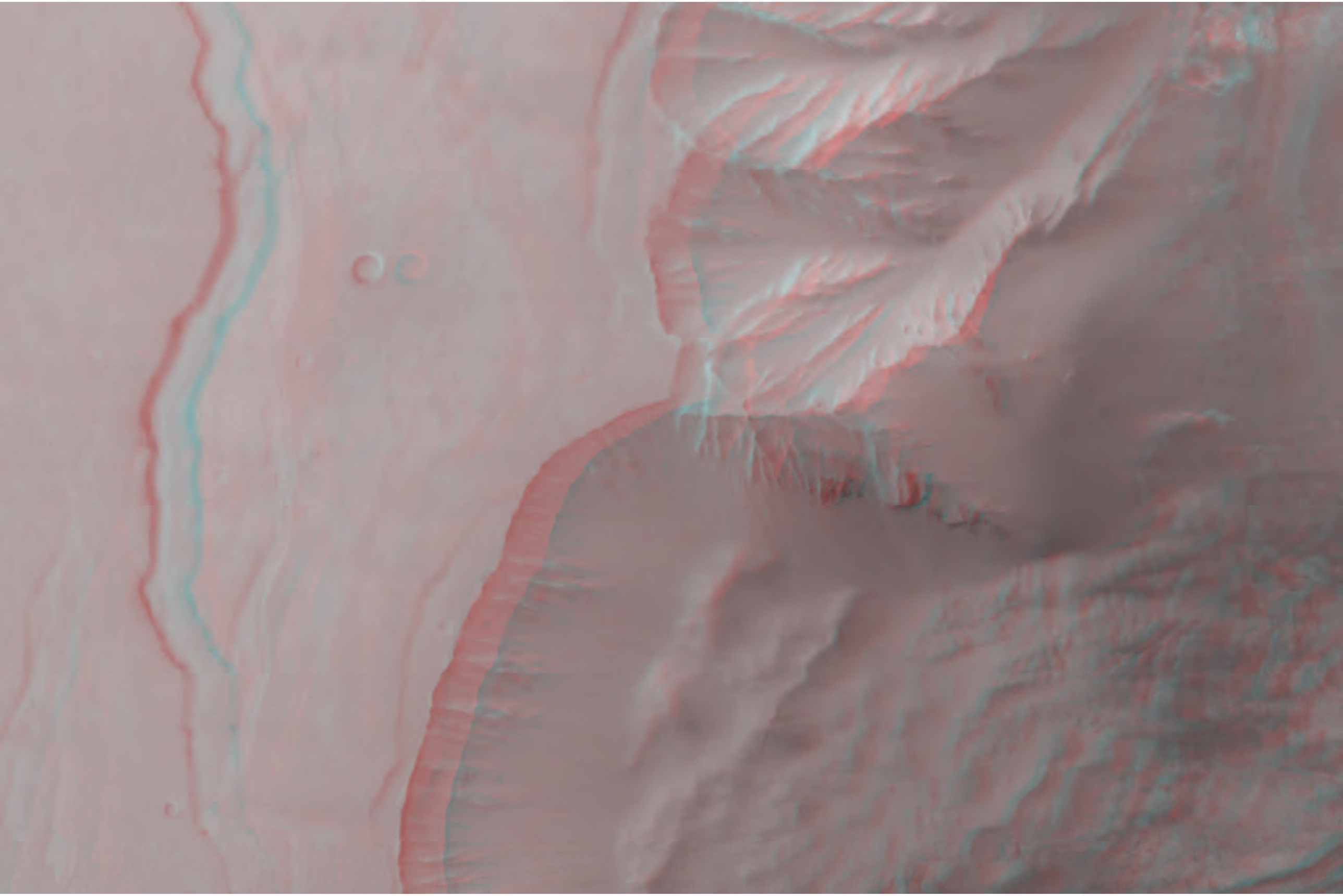
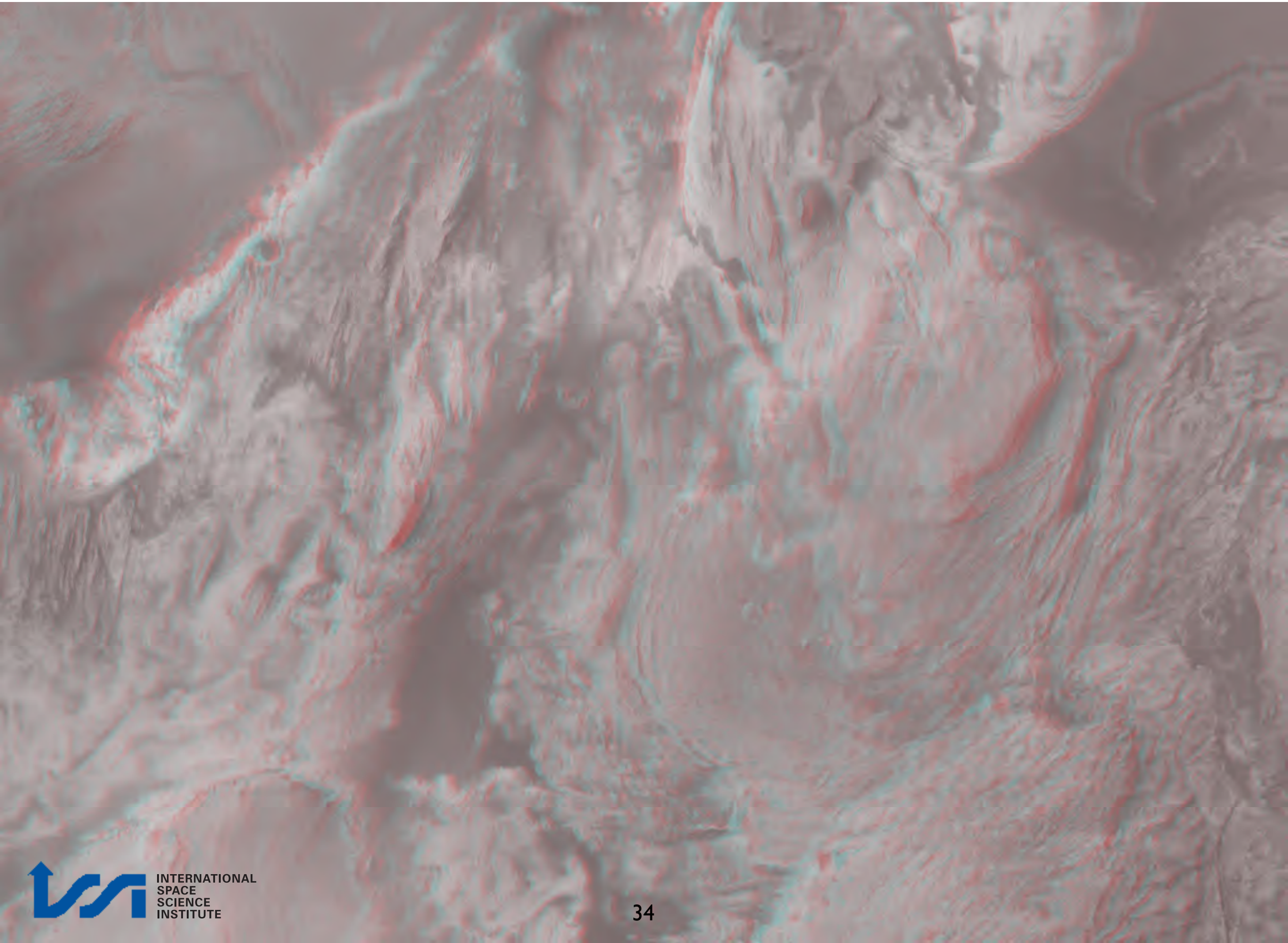
HRSC anaglyph

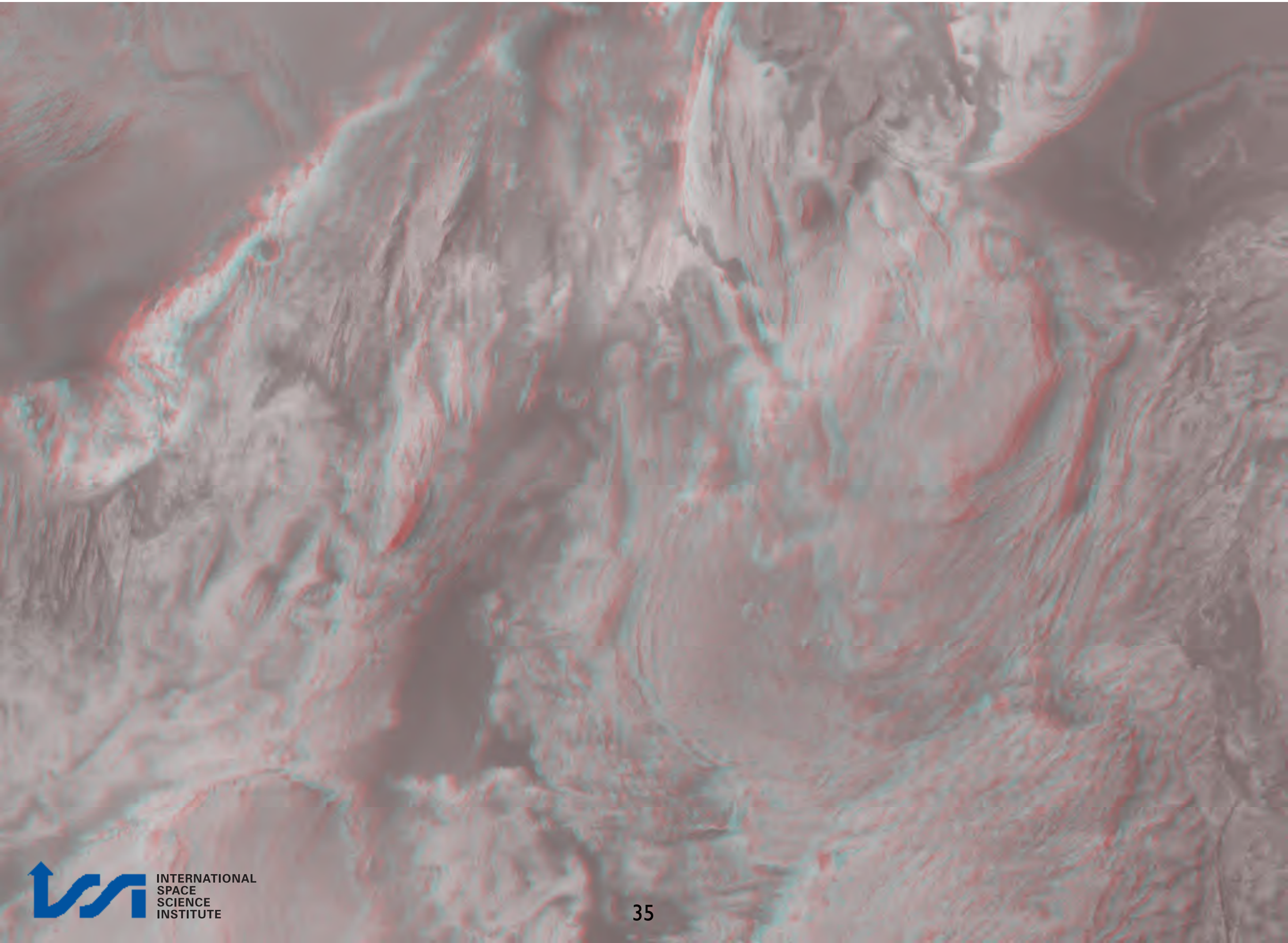


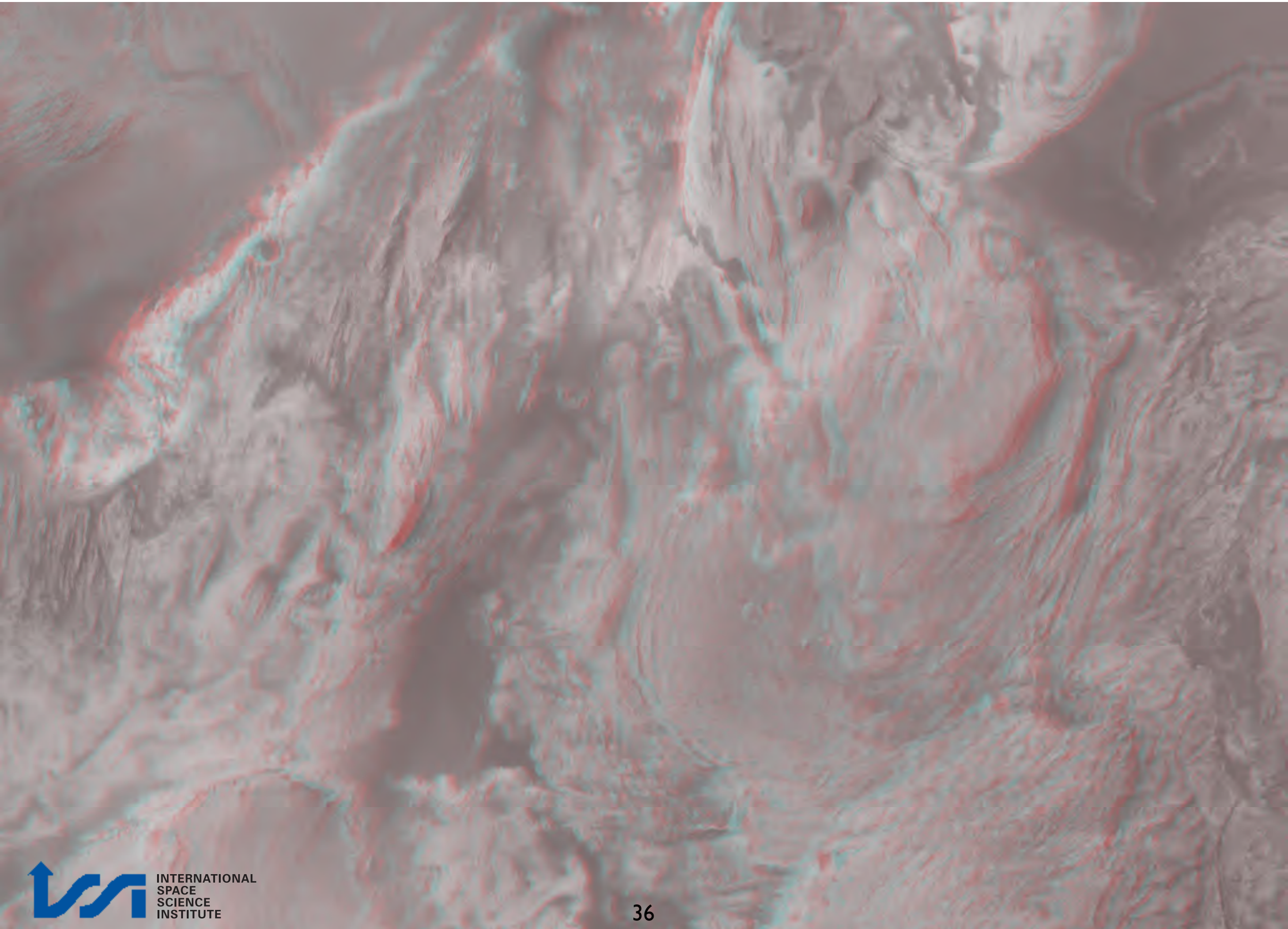
HRSC orbit 360

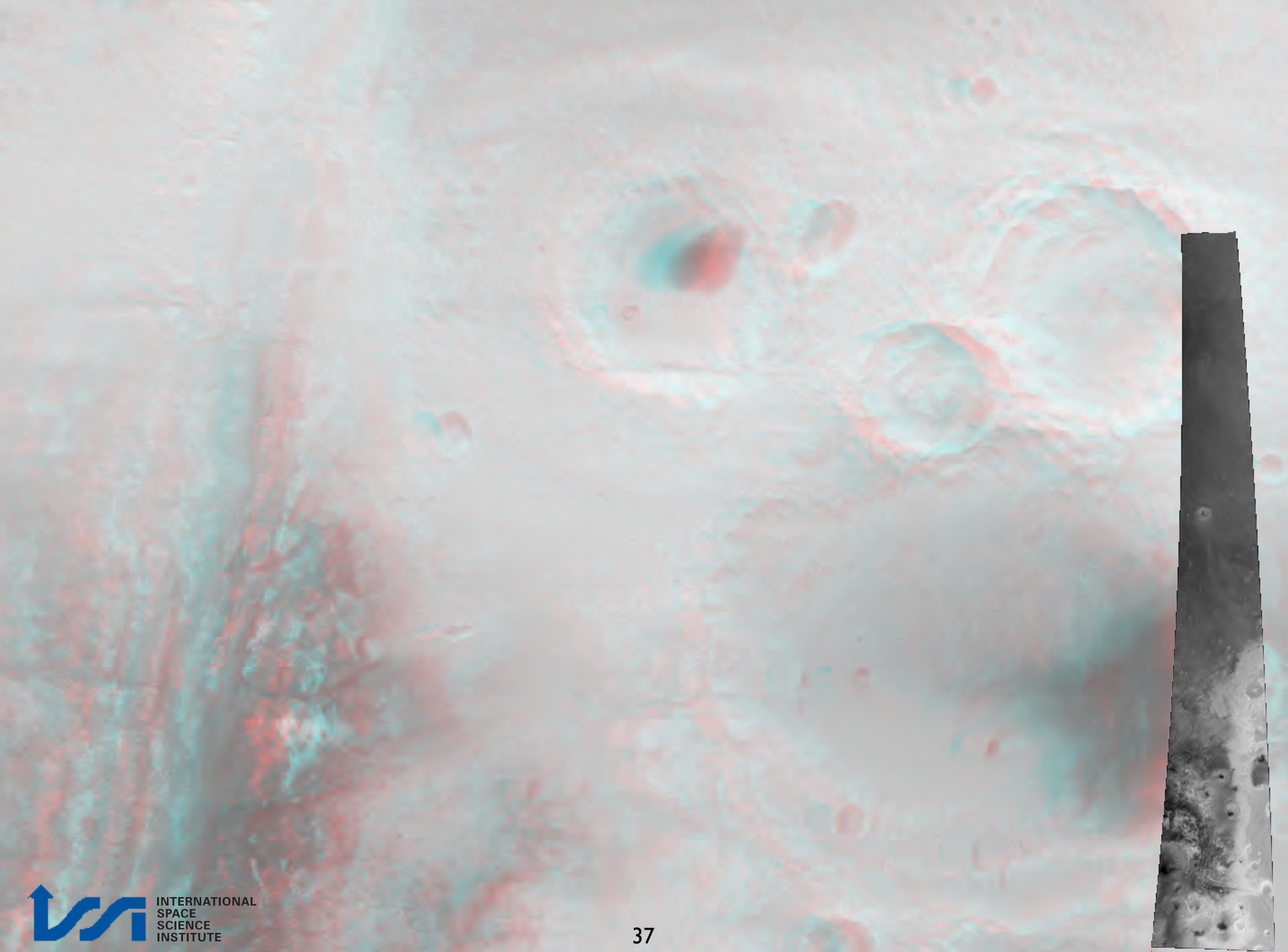












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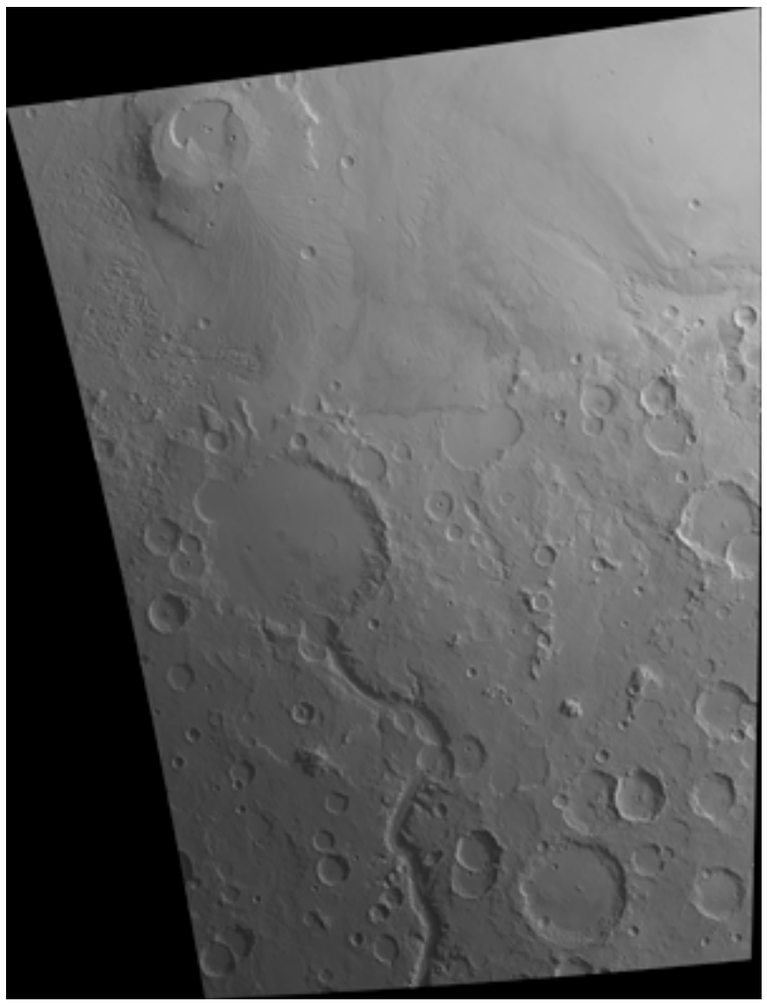
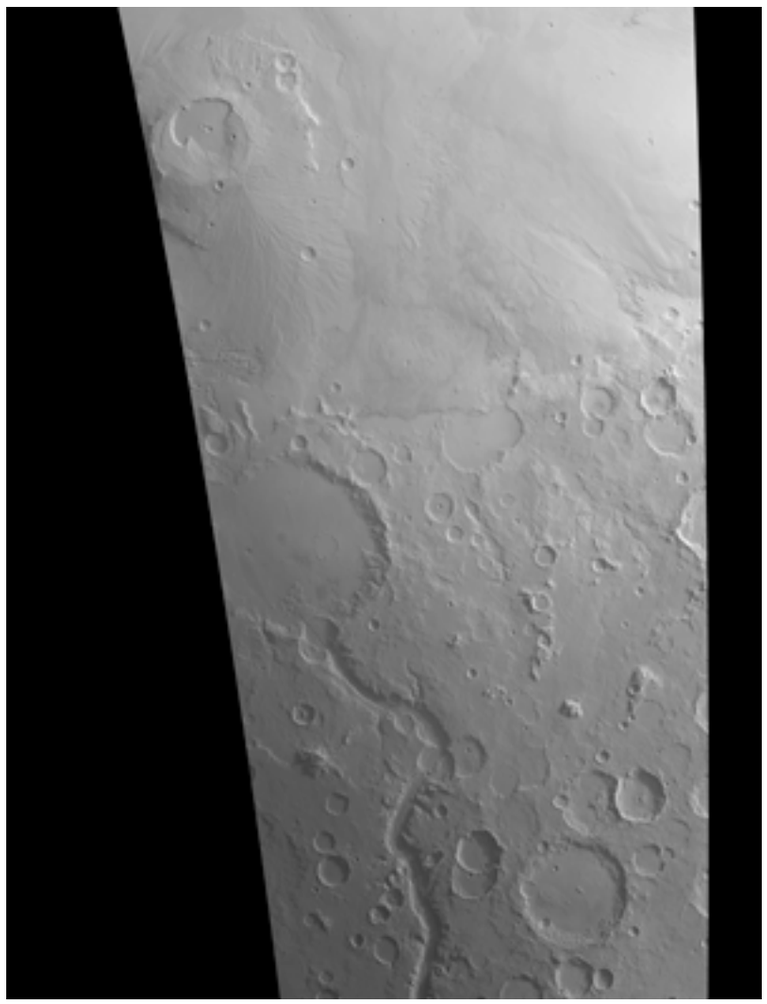
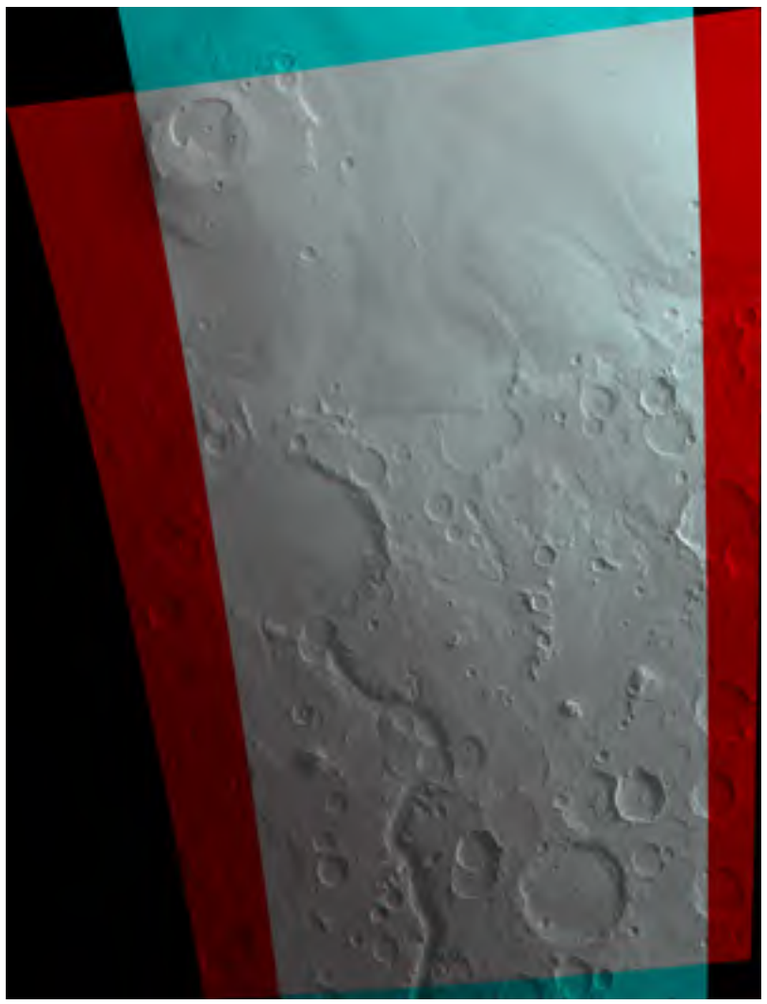
Gusev: anaglyph

Nadir



Stereo I





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dlrto8 & dlrvic2png

WHAT TO DO (shown just for one band):

- Convert vicar file from 16 to 8 bit (dlrto8)
- Export 8 bit vicar file to .png

```
HRORTHO

$HWLIB/dlrto8 inp=nadir out=nadir_8bit.vic dnmin=0


$HWLIB/dlrvic2png inp=nadir_8bit.vic out=NADIR.PNG
```

- Combine rgb single files in RGB file

Full procedure (i)

Example

```
#!/bin/tcsh

# MINIVICAR VARIABLES
setenv V2TOP /<PATH>/minivicar/vicar
source $V2TOP/vicset1.csh
source $V2TOP/vicset2.csh
setenv M94GEOCAL $V2TOP/../GEOCAL
set path = ( $path $V2TOP )

# VARIABLES FOR KERNELS AND DATA
setenv LEAPSECONDS $V2TOP/../kernels/NAIF0008.TLS
setenv CONSTANTS $V2TOP/../kernels/PCK00008.TPC
setenv SUNKER $V2TOP/../kernels/DE405S.BSP
setenv HWSPICE_TF $V2TOP/../kernels/MEX_V08.TF
setenv HWSPICE_TI $V2TOP/../kernels/MEX_HRSC_V03.TI
setenv HWSPICE_TSC $V2TOP/../kernels/MEX_070321_STEP.TSC
setenv HWSPICE_BC ./ATNM_P030602191822_00135.BC
setenv HWSPICE_BSP ./ORMM__050301000000_00117.BSP


# HRORTHO
$HWLIB/hrortho inp=H1542_0009_ND2.IMG out=nadir0 sl_inp=35000 nl_inp=30000 ori=spice a_axis=3396.19 b_axis=3396.19
c_axis=3396.19

$HWLIB/hrortho inp=H1542_0009_S12.IMG out=stereo1 fitto=nadir0 ori=spice a_axis=3396.19 b_axis=3396.19
c_axis=3396.19
```

Full procedure (ii)

Example

```
# 8 BIT CONVERSION

$HWLIB/dlrto8 inp=nadir0 out=nadir0_8bit.vic dnmin=0
$HWLIB/dlrto8 inp=stereo1 out=stereo1_8bit.vic dnmin=0


# EXPORT TO PNG

$HWLIB/dlrvic2png inp=nadir0_8bit.vic out=NADIR0.PNG
$HWLIB/dlrvic2png inp=stereo1_8bit.vic out=STEREO1.PNG
```