OSIRIS REx
Science Processing & Operations Center (SPOC) and Science Engineering Peer Review

April 21 - 23, 2015

OSIRIS-REx™
ASTEROID SAMPLE RETURN MISSION

Science Value Maps

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Sample Site Science WG lead

Agenda

- Driving MRD requirements
- Requirements for map processing software
- Required inputs to map
- Nominal map development process
- Operational schedule
- Status of algorithm development
- Minimal mission scenario impact
- Off nominal discussion
- Work to go

Relevant MRD Requirements for Science Value Maps

- Driving Requirement:

  MRD-114 — Analyze the surface of Bennu to identify at least one potential sample site of scientific value.

- Relevant Requirement:

  MRD-140 — For ≥80% of the asteroid surface, map those spectral features listed in MRD-140 Table (Absorption Features of Key Mineralogical & Organic Molecules) with ≥ 5% absorption depth at ≤50 m spatial resolution.

Map Requirements (Global and Site-Specific)

- Rank the scientific value on the surface of Bennu, consisting of 4 sub-science value maps (sub-SVMs), in order of importance to the mission:
    1) Science Value Chemical Composition Map
    2) Science Value Mineralogy Map
    3) Science Value Geological Feature Map
    4) Science Value Temperature Map
- These maps projected on the Global Shape Model
- Compatible with the mission's data visualization tool
- Original input science data traceable for data evaluation (input data, algorithm definition, weighting factor) by scientists

Draft Science Value Map Requirements (Global Chemical Composition)

Number	Requirement	Rationale
SVM.GCCM.01	The SPOC shall detect and score the presence of aliphatic hydrocarbon feature for each facet of the Global Shape Model. The detection score is assigned by setting 1 if above detection limit and 0 below detection limit	This value is needed for the generation of the Science Value Chemical Composition map at global scale. The computation shall occur for each facet of the global shape model.
SVM.GCCM.02	The SPOC shall detect and score the presence of polycyclic aromatic hydrocarbon (PAHs) feature for each facet of the Global Shape Model. The detection score is assigned by setting 1 if above detection limit and 0 below detection limit	This value is needed for the generation of the Science Value Chemical Composition map at global scale. The computation shall occur for each facet of the global shape model.
SVM.GCCM.03	The SPOC shall detect and score the presence of unknown organic spectral feature for each facet of the Global Shape Model. The detection score is assigned by setting 1 if above detection limit and 0 below detection limit	This value is needed for the generation of the Science Value Chemical Composition map at global scale. The computation shall occur for each facet of the global shape model.
SVM.GCCM.04	The SPOC shall compute the Organics/Silicate (O/S) ratios for comparison to the O/S ratios from the best representative lab data of primitive astro material for each facet of the Global Shape Model	This value is needed for the generation of the Science Value Chemical Composition map at global scale. The computation shall occur for each facet of the global shape model.
SVM.GCCM.05	The SPOC shall compute the CH2/CH3 ratio in aliphatic hydrocarbon for comparison to the CH2/CH3 ratio from the best representative lab data of primitive astro material for each facet of the Global Shape Model	This value is needed for the generation of the Science Value Chemical Composition map at global scale. The computation shall occur for each facet of the global shape model.
SVM.GCCM.06	The SPOC shall detect and score the Adsorbed H2O for each facet of the Global Shape Model. The detection score is assigned by setting 1 if above detection limit and 0 below detection limit	This value is needed for the generation of the Science Value Chemical Composition map at global scale. The computation shall occur for each facet of the global shape model.
SVM.GCCM.06	The SPOC shall detect and score the absorbed molecules for each facet of the Global Shape Model. The detection score is assigned by setting 1 if above detection limit and 0 below detection limit	This value is needed for the generation of the Science Value Chemical Composition map at global scale. The computation shall occur for each facet of the global shape model.

Required Inputs

- Data products that feed into Science Value Maps:

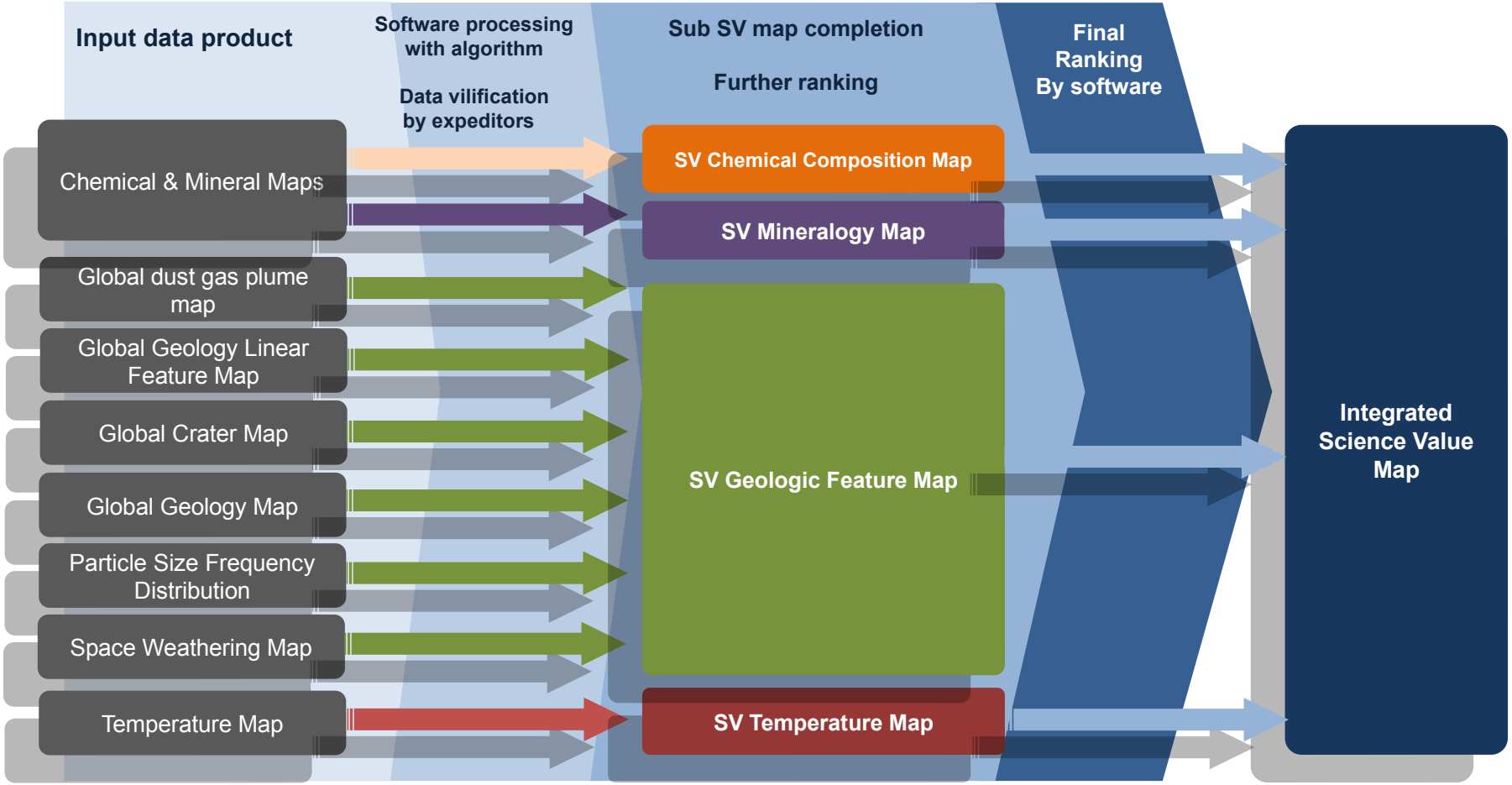
1) Mineral and Chemical Maps (MRD-118)
    for Science Value Chemical Composition Map
        Science Value Mineralogy Map

2) Global Geology Linear Feature Map (MRD-139)
3) Global Dust Gas Plume Map (MRD-142)
4) Global Crater Map (MRD-136)
5) Particle Size Frequency Distribution (MRD-116, -137)
6) Global Geology Map (MRD-138)
7) Space Weathering Map (MRD-542)
    for Science Value Geological Feature Map
        Science Value Temperature Map

8) Temperature Map (MRD-155, -411)
    for Science Value Temperature Map

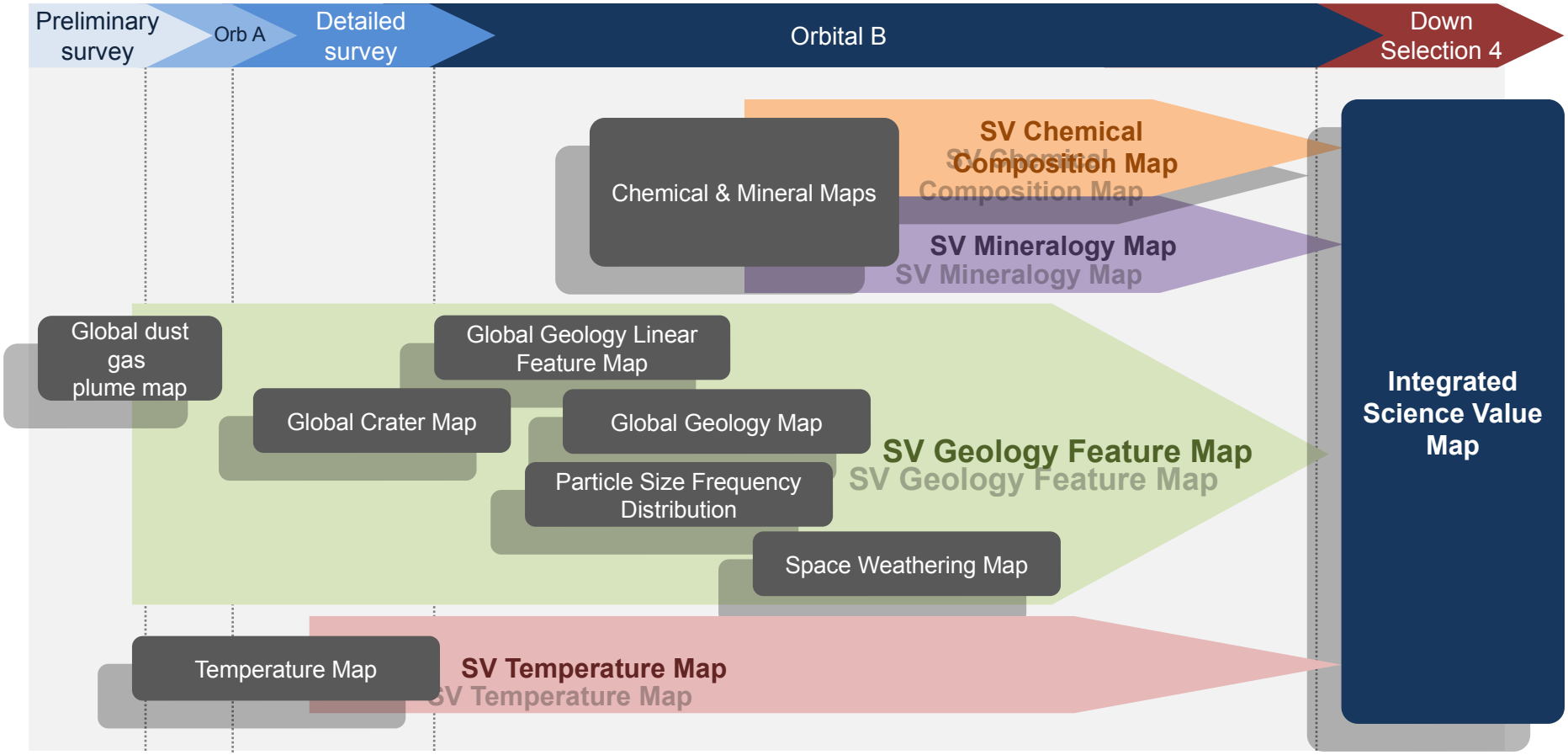
Nominal Map Development Process

- All of the input data products are not raw data, but processed data or map products established by other working groups. They are projected and included to the data visualization tool prior to our processing.
- All we do for SVM is to process with algorithm with the software, and evaluate the data reliability.
- Data with uncertainty won't be simply included (expeditor scientists will evaluate the input data quality).



Nominal Map Development Process

- We will develop SVMs incrementally as soon as each input data product coming in.
- Algorithm for SVMs are cumulative: Each input data product is independent and considered as science value factor as its own.



Science Value Map Schedule and Inputs (Global)

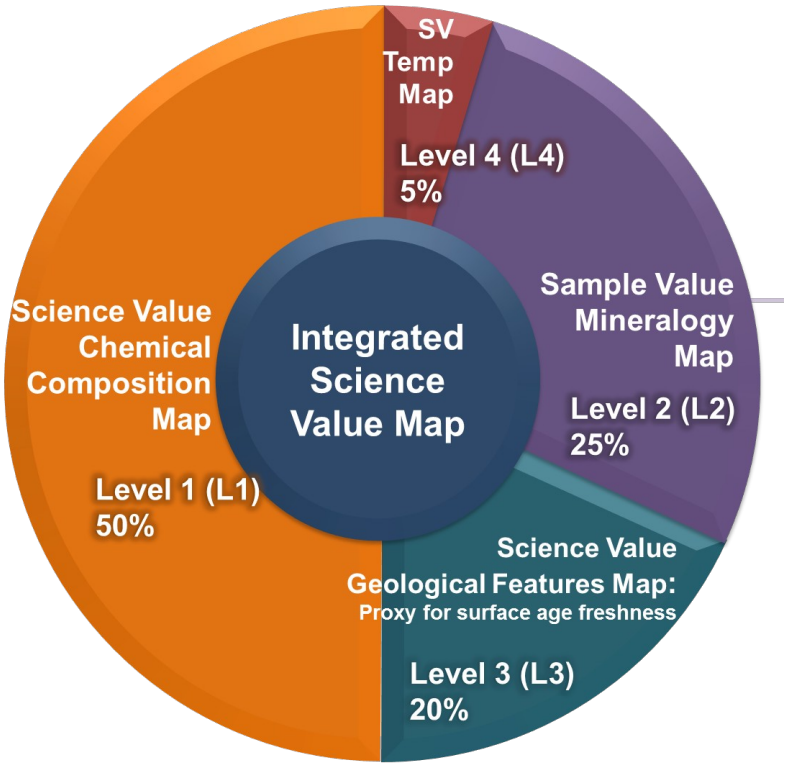
- All products for map available: 4/18/19
- Processing begins on or before: 4/19/19
- Map Complete: 4/23/19
- Map product lead: Keiko Nakamura-Messenger, Harold C. Connolly Jr.
- Backup data product lead: Lindsay Keller, Danny Glavin, Tim McCoy, Josh Emory

Science Value Map Schedule and Inputs (Final Site Selection)

- All products for map available (Sites 1,2 Site-specific Space Weathering Maps): 7/29/19, 8/12/19
- Processing begins on or before: (Sites 1,2, Site-specific geologic map): 7/19/19, 8/2/19
- Science Value Map Complete: (Both Sites): 8/14/19
- Map product lead: Keiko Nakamura-Messenger, Harold C. Connolly Jr.
- Backup data product lead: Lindsay Keller, Danny Glavin, Tim McCoy, Josh Emory

Status of Algorithm Development

- Algorithm for SVM is simple scoring system, well-established and evaluated.



- The SVM algorithm is simple scoring system weighing on 1) Organic/water enrichment feature
  2) Mineralogical Diversity
  3) Asteroid surface age/freshness

  To high science value area to stand-out and eliminate uncertain factors

- The SVM algorithm has been coded and experimented with the proposed algorithm in MATLAB by an expert.

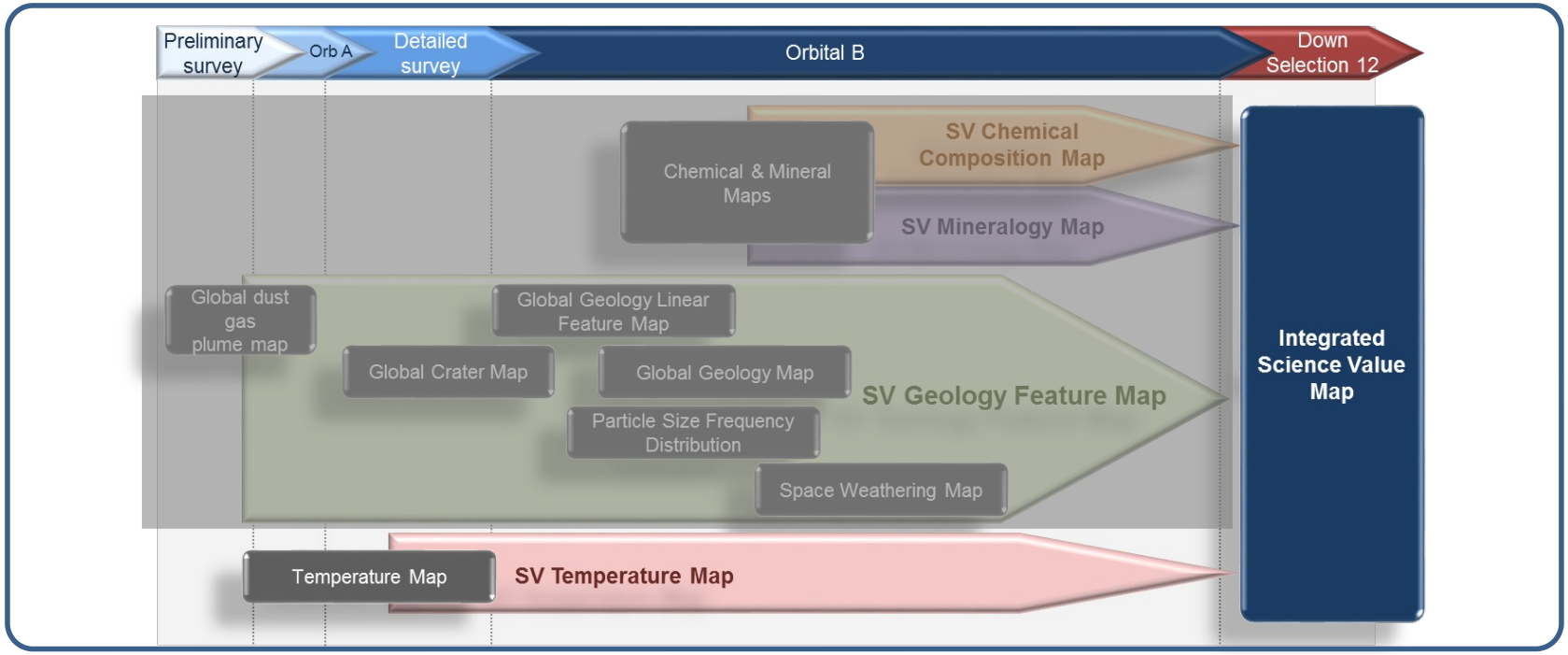
- Assessed all possible cases -nearly 8 million possibility sets of inputs plotted histograms of resulting science value scores.

- Sensitivity analysis via the MATLAB implementation to see how the algorithm behaves in different scenarios.

Minimal Mission Scenario

- The Science Value Map under minimal mission scenario will be produced *by best effort basis*.
  - Just as nominal mission scenario, we will develop SVMs incrementally as quick as any new input data product available to process, whether it's full scale or partial.
  - In charge scientists from SSSWG will evaluate the incoming data quality.
  - This manner will be also applied in contingency scenario

e.g. below: when only temperature map is available, SV temperature map will be our Science Value factor.

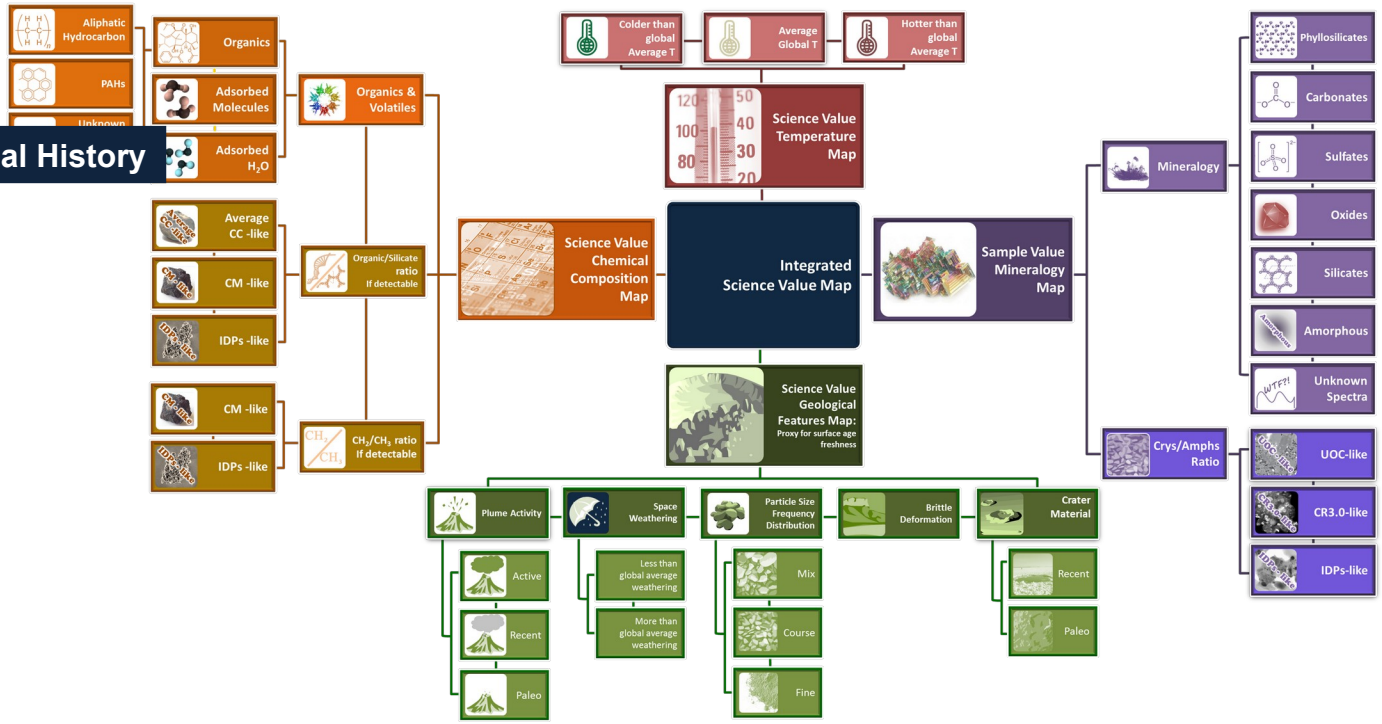


Off-Nominal Discussion

- SVM concept is an attempt to capture every key element of primary science goal of the mission.
- As described previously, each incoming data products will be treated individually, but the science behind them is cross-correlated, making any data product proxies for one another.

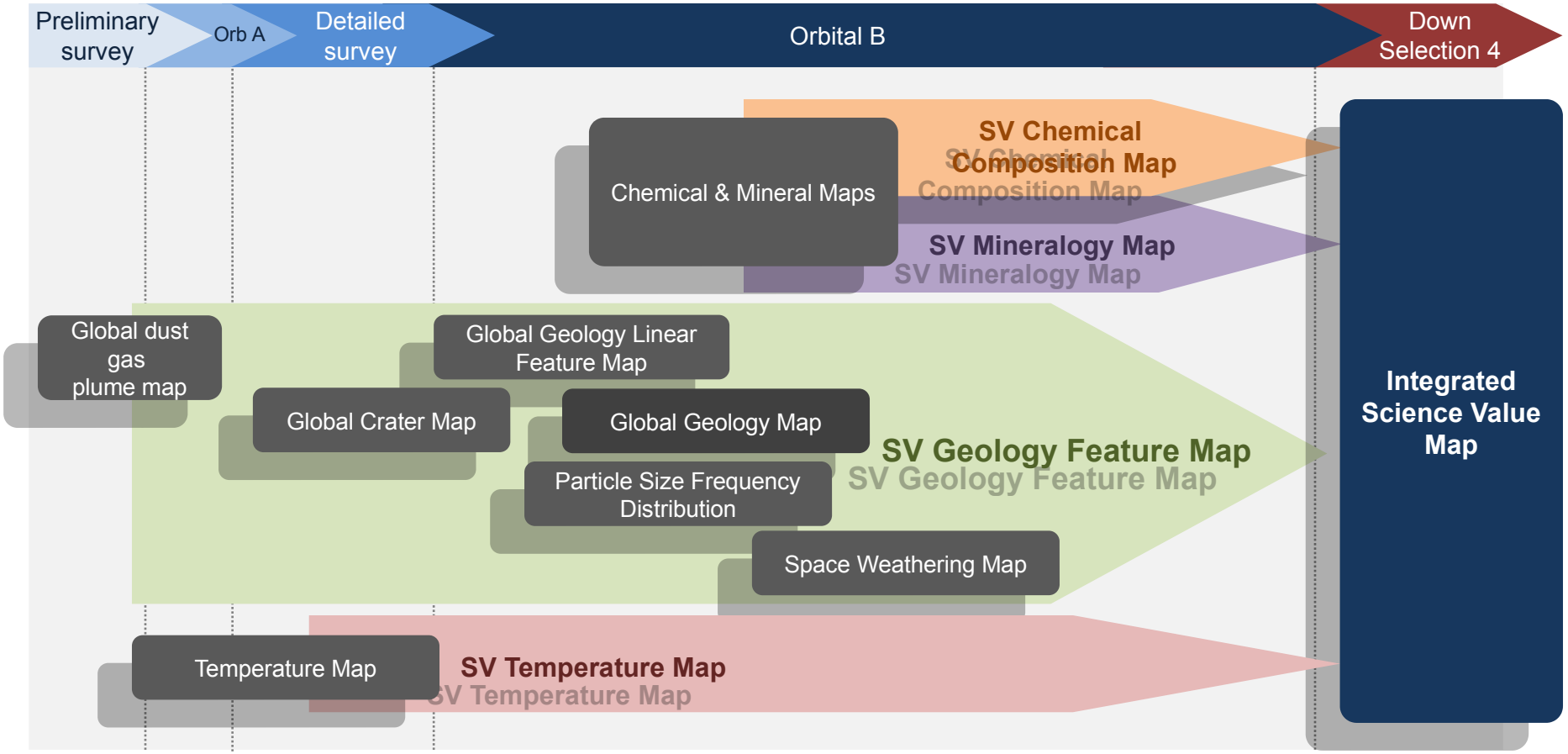
Key elements support primary goal of OSIRIS-REx

- Presolar Phase
- Early Geological History
- Surface Regolith Process
- Dynamic Evolution
- Chemical & Mineralogical Diversity
- Carbonaceous Chondrites
- Cometary Material
- Preserved Environment



Off-Nominal Discussion

- Internal Redundancy:
  - Global Geology Map is a back-up product to fill missing info we need for SV Geological Feature Map.



Work to go

- Final delivery of requirements and algorithm descriptions to SPOC software development team (June 1, 2015)
- Requirements review and signoff (July 31, 2015)
- Support for SPOC V&V efforts (ongoing)

Next Topic (This slide will be done for you)

#	Start Time	Topic	Presenter
	7:45 AM	Coffee/Refreshments	
1	8:00 AM	Welcome	E. Beshore
2	8:10 AM	OSIRIS-REx Mission Overview and Priorities	D. Lauretta
3	9:10 AM	DRM Science Collection Overview	B. Boynton/J. Kidd
	9:55 AM	Break	
4	10:10 AM	Ground System Overview	J. Gal-Edd
5	11:10 AM	SPOC Overview	C. Shinohara
	11:55 AM	Lunch	
6	12:55 PM	Operations Overview	S. Barnes
7	1:40 PM	SPOC/Science Planning Process	B. Boynton/C. Hergenrother
	2:40 PM	Break	
8	2:55 PM	SPOC Implementation Process	S. Barnes
9	4:25 PM	SPOC Downlink Process	S. Balram
	4:55 PM	Board Caucus	Board

Backup