

- Back To Base - Final
- Expedition Completion

All the surveys, including the surface mapping have a data to store the progress and the value goes from 0% to 100%. By convention, anything going > 100% stays at 100%.

Before the player/AI can setup a survey expedition, some prerequisites are tested, there are 4 of them:

1/ ocean check: a targeted region cannot be an ocean without landmass. It is subject to change, but in the far future...

2/ exploration status check:

- * Not Engaged: the region is available for the survey.
- * In Process: no additional expedition can be set up in a region already in process of being explored.
- * Completed: no expedition is needed.
- * Halted: no additional expedition can be set up in a region already in process of being explored, even with a halted status.

3/ if the colony has any survey vehicles in its storage, an expedition can be set.

4/ in the case of the targeted region doesn't contain any player/AI's settlement, a travel duration calculation must be made to see if the current selected vehicles have enough range to travel to it AND to process the survey.

if more than one settlement, calculate the duration from all the settlement and do a mean between them.

The main process is the following:

- a/ update of the phase of the current sungp.
- b/ update the surface mapping and survey progression %.
- c/ process the survey according to the rules of each type of survey (see 4.4.3, 4.4.4, and 4.4.5).
The outcome influence how the spot will be generated.

If there is a combined test the two outcomes are added to each other for a final outcome:

The numeric values are extracted from these outcome, summed and the result is the final outcome

if the combined numeric value is < -3, then =-3 if it is > +2, then = +2

If a sungp has only one of the two characteristics / abilities, process the only one test and add -1 to it for the final outcome.

- d/ when the survey reaches 100% AND the surface mapping (if any) reaches 100%, the exploration status passes to Completed and all the sungp have a Back To Base - Final or Expedition completion phase set, according to the situation each of them is currently on
- if the survey reaches 100%, the MAPSP is at 100% and sMAPd is updated (and SUSP / sEXd = 0%)
- if the mapping reaches 100%, the SUSP is at 100% and sEXd is updated (and MAPSP/ sMAPd = 0%)

Current Phase	Exploration Completed Phase
In Transit To Site	Back To Base - Final
<xxx> Survey	Back To Base - Final
Back To Base	Back To Base - Final
Redirect to New Base	Back To Base - Final
Resupplying	Expedition Completion
Back To Base - Final	no change

4.4.3. Geological Survey

The Geological Survey (GS) allow to map the geophysical aspect of a region, to probe for its possible resources spots and to discover if it contains any features and/or artefacts.

Here is the step c of 4.4.2 in details:

- process for EACH region's resource spots (regardless if initially discovered or not):

* process of survey test, depending of the type of resource spot. Test for each sungp on site. Once a spot is discovered, no other sungp can do a survey test for the same spot's type in the current session.

The sungp who has discovered the spot isn't reused for the other spots to process until the end of the session.

If there are no more sungp available for further test, the session is ended.

Here are the details:

Step Process Track	Survey Tests Sheet - Gas Field
Main Test	Detection - EMR / Survey Geological
Combined Test	Detection - Ground Sampling / Survey Geological
Difficulty Sum	REMsurvey + REM WEAGES + TectonicActivityMod TectonicActivityMod = Dead +1 Hotspot 0 Plastic -2 Plate Tectonic -4 Platelet Tectonic -8 Extreme -10
Spot Generation Chart	Gas
Outcome - Total Failure	Generation Mod: -10
Outcome - Significant Failure	Generation Mod: -5
Outcome - Failure	Generation Mod: -3
Outcome - Success	Generation Mod: 0
Outcome - Significant Success	Generation Mod: 0
Outcome - Critical Success	Generation Mod: +1

Step Process Track	Survey Tests Sheet - Hydro Location
Main Test	Detection - Visual / Survey Geological
Combined Test	Hydrosphere Area (use direct % w/ URES no REMsurvey diff but the two mods) if liquid if ice sheet (use direct % / 2) if crust (use direct % / 4)
Difficulty Sum	REMsurvey + REM WEAGES + LandTypeMod + ClimateMod + TectonicActivityMod + ReliefMod TectonicActivityMod = Dead -1 Hotspot 0 Plastic +1 Plate Tectonic +2 Platelet Tectonic -5 Extreme -10 LandTypeMod = 1/8= -3/-2 ; 2/9= -4/-3 ; 3/10= -6 ; 4/11= -3/-2 ; 5/12= 0/+1 ; 6/13= +1/+2 ; 14= -10 ; 15= -10 ClimateMod = I: +3 ; II: +1 ; III: -1 ; IV: -4 ; V: +2 ; VI: 0 ; VII: -1 ; VIII: -2 ; IX: -3 ; X: -10 ReliefMod rivers/lakes = plain 0 broken +1 mountainous +2
Spot Generation Chart	Surface Hydrosphere
Outcome - Total Failure	Generation Mod: -10
Outcome - Significant Failure	Generation Mod: -10
Outcome - Failure	Generation Mod: -5
Outcome - Success	Generation Mod: 0
Outcome - Significant Success	Generation Mod: +1
Outcome - Critical Success	Generation Mod: +2

Step Process Track	Survey Tests Sheet - Icy Ore Field
Main Test	Detection - Visual / Survey Geological
Combined Test	If Ice Sheets: Hydrosphere Area (use direct % w/ URES no REMsurvey diff but the two mods) If Ice Crust: N/A Else: Detection - Ground Sampling / Survey Geological
Difficulty Sum	REMSurvey + REM WEAGES + TectonicActivityMod TectonicActivityMod = Dead +2 Hotspot +2 Plastic +1 Plate Tectonic 0 Platelet Tectonic -5 Extreme -10
Spot Generation Chart	Ore Deposit
Outcome - Total Failure	Generation Mod: Ice Sheet = -10 / Ice Crust = -8
Outcome - Significant Failure	Generation Mod: Ice Sheet = -6 / Ice Crust = -4
Outcome - Failure	Generation Mod: Ice Sheet = -3 / Ice Crust = -2
Outcome - Success	Generation Mod: Ice Sheet = 0 / Ice Crust = 0
Outcome - Significant Success	Generation Mod: Ice Sheet = +1 / Ice Crust = +1
Outcome - Critical Success	Generation Mod: Ice Sheet = +1 / Ice Crust = +2

Step Process Track	Survey Tests Sheet - Carbonaceous Ore Field
Main Test	Detection - Visual / Survey Geological
Combined Test	Detection - Ground Sampling / Survey Geological
Difficulty Sum	REMSurvey + REM WEAGES + TectonicActivityMod TectonicActivityMod = Dead 0 Hotspot +1 Plastic 0 Plate Tectonic -1 Platelet Tectonic -6 Extreme -10
Spot Generation Chart	Ore Deposit
Outcome - Total Failure	Generation Mod: -10
Outcome - Significant Failure	Generation Mod: -6
Outcome - Failure	Generation Mod: -2
Outcome - Success	Generation Mod: 0
Outcome - Significant Success	Generation Mod: +1
Outcome - Critical Success	Generation Mod: +2

Step Process Track	Survey Tests Sheet - Metallic Ore Field
Main Test	Detection - EMR / Survey Geological
Combined Test	N/A
Difficulty Sum	REMSurvey + REM WEAGES + TectonicActivityMod TectonicActivityMod = Dead +1 Hotspot +1 Plastic 0 Plate Tectonic 0 Platelet Tectonic -5 Extreme -10
Spot Generation Chart	Ore Deposit
Outcome - Total Failure	Generation Mod: -9
Outcome - Significant Failure	Generation Mod: -4
Outcome - Failure	Generation Mod: -2
Outcome - Success	Generation Mod: 0
Outcome - Significant Success	Generation Mod: +1
Outcome - Critical Success	Generation Mod: +2

Step Process Track	Survey Tests Sheet - Rare Metals Ore Field
Main Test	Detection - EMR / Survey Geological
Combined Test	N/A
Difficulty Sum	REMSurvey + REM WEAGES + TectonicActivityMod TectonicActivityMod = Dead 0 Hotspot 0 Plastic -2 Plate Tectonic -3 Platelet Tectonic -7 Extreme -10
Spot Generation Chart	Ore Deposit
Outcome - Total Failure	Generation Mod: -10
Outcome - Significant Failure	Generation Mod: -10
Outcome - Failure	Generation Mod: -6
Outcome - Success	Generation Mod: -2
Outcome - Significant Success	Generation Mod: 0
Outcome - Critical Success	Generation Mod: +1

Step Process Track	Survey Tests Sheet - Uranium Ore Field
Main Test	Detection - EMR / Survey Geological
Combined Test	Detection - NBC / Survey Geological
Difficulty Sum	REMSurvey + REM WEAGES + TectonicActivityMod TectonicActivityMod = Dead 0 Hotspot 0 Plastic -2 Plate Tectonic -3 Platelet Tectonic -7 Extreme -10
Spot Generation Chart	Ore Deposit
Outcome - Total Failure	Generation Mod: -9
Outcome - Significant Failure	Generation Mod: -6
Outcome - Failure	Generation Mod: -3
Outcome - Success	Generation Mod: 0
Outcome - Significant Success	Generation Mod: 0
Outcome - Critical Success	Generation Mod: +1

Step Process Track	Survey Tests Sheet - Aquifer
Main Test	Detection - EMR / Survey Geological
Combined Test	N/A
Difficulty Sum	REMSurvey + REM WEAGES + LandTypeMod + TectonicActivityMod TectonicActivityMod = Dead +1 Hotspot 0 Plastic -1 Plate Tectonic -3 Platelet Tectonic -7 Extreme -10 LandTypeMod = 1/8= -4/-3 ; 2/9= -5/-4 ; 3/10= -7 ; 4/11= -4/-3 ; 5/12= -1/0 ; 6/13= 0/+1 ; 14= -10 ; 15= -10 By the number of Hydro Location in the region: +1 hydro liquid 0 hydro ice sheet -2 hydro ice crust -4
Spot Generation Chart	Aquifer
Outcome - Total Failure	Generation Mod: -8
Outcome - Significant Failure	Generation Mod: -4
Outcome - Failure	Generation Mod: -2
Outcome - Success	Generation Mod: 0
Outcome - Significant Success	Generation Mod: +1
Outcome - Critical Success	Generation Mod: +2

The Difficulty Sum is stored for the type of REM Survey into the expedition data structure. the REM WEAGES is also stored into a separate data and this one is updated each time the WEAGES effects in effect in the targeted region are updated.

The Generation Mod are applied right after the tests are processed and are used only for the current session; they are discarded once done. The way it is integrated means that even in case of failure, a resource spot can be generated, it's just more improbable.

The test is processed according the URES, and if there is a combined test, the related rule in the step c of 4.4.2is applied. Before the URES data are sent to this system, there is also a universal modifier applied to the used ability relative to the number of SUN inside the sungp:

SUnMod = + [SQRT(# of vehicles in the sungp)] capped at max +5 of bonus

This modifier is added to the group's ability (abilities if combined test). Thus, bigger is a sungp, better chance the group has to detect something, but this bonus is capped and so has its limitations.

In final the total difficulty = Difficulty Sum + REM WEAGES + SpotDiffStack (see next step - outcome process) + SUnMod

* The outcome is processed and spot's generation can be applied if allowed:

: If Generation Mod = -10, or SpotDiffStack <= -10, no generation of the spot for this session. If not, the spot is generated as below:

$x = \text{random}(1 - 10) + \text{GenerationMod}$ if $x < 1 \Rightarrow$ no generation of the spot for this session if $x > 10 = 10$

x is confronted to the spot's rarity in the correct table defined in Spot Generation Chart

These charts allows to generate a resource spot according to x and spot's rarity.

All have the same 8 sizes, and they are linked to a SpotDiffStack and specific data for further calculations. The details of these calculations are below each chart.

The SpotDiffStack is a difficulty modifier for the subsequents session for the spot. Its use is to avoid to generate too much spots, especially if big ones are generated. And so it keeps a certain equilibrium.

The max value of this modifier is -11.

Gas Size Spot Rarity	Minimal	Tiny	Small	Modest	Average	Significant	Vast	Immense
Rare	1 - 4	5 - 7	8 - 9	10	x	x	x	x
Uncommon	1 - 2	3 - 5	6 - 8	9	10	x	x	x
Present	1	2	3 - 4	5 - 7	8 - 9	10	x	x
Common	x	1	2	3 - 4	5 - 7	8 - 9	10	x
Abundant	x	x	x	1	2	3 - 5	6 - 8	9 - 10
Rich	x	x	x	x	1	2	3 - 6	7 - 10
SpotDiffStack	0	-1	-2	-3	-4	-5	-6	-7
SurfaceMod	0.00000000 008 (10)	0.00000000 08 (9)	0.00000000 8 (8)	0.00000008 (7)	0.0000008 (6)	0.000008 (5)	0.00008 (4)	0.0008 (3)
Depth	400-1200	500-1500	600-1800	700-2100	800-2400	900-2700	1000-3000	1100-3300
Thickness	150	200	250	300	350	400	450	500

Additional Modifier:

Region Relief: Plain 0 Broken -1 Mountainous -2

min depth(w) = rand(depth ranges)

usable depth(y) = rand(thickness ranges) y is in meters

StM in meters(a) = StM * 10^6

max extractable volume(z) = (a * SurfaceMod) * y in cubic meters rto -3

extractable volume left = z

spot size (in IL) = SQRT(a) int()

used spot size = 0

Surface Hydrosphere - Rivers Size / Flow Multiplier Spot Rarity	Minimal	Tiny	Small	Modest	Average	Significant	Vast	Immense
Rare SurfReg divider	x2	x3	x3	x5	x5	x7	x8	x10 13.212
Uncommon SurfReg divider	x4	x5	x6	x9	x10	x13	x16	x20 6.606
Present SurfReg divider	x7	x9	x11	x15	x18	x23	x28	x35 3.775
Common SurfReg divider	x10	x14	x17	x22	x27	x34	x42	x52 2.517
Abundant SurfReg divider	x13 258.17	x17 129.087	x21 64.543	x27 32.271	x34 16.135	x42 8.352	x52 4.057	x65 2.014
Rich SurfReg divider	x14	x19	x23	x30	x37	x46	x57	x72 1.83
SpotDiffStack	-1	-1	-1	-1	-2	-3	-5	-8
(x)	1	2	3 - 4	5	6 - 7	8	9	10
Flow Base	2000	2000	2100	2400	2400	2800	2800	3200

base: abundant to rich */1.1 to common */1.75 => present */1.5 => uncommon */1.75 => rare */2

Surface Hydrosphere - Lakes Size Spot Rarity	Minimal	Tiny	Small	Modest	Average	Significant	Vast	Immense
Rare	1 - 4	5 - 7	8 - 9	10	x	x	x	x
Uncommon	1 - 2	3 - 5	6 - 8	9	10	x	x	x
Present	1	2	3 - 4	5 - 7	8 - 9	10	x	x
Common	x	1	2	3 - 4	5 - 7	8 - 9	10	x
Abundant	x	x	x	1	2	3 - 4	5 - 7	8 - 10
Rich	x	x	x	x	1	2	3 - 6	7 - 10
SpotDiffStack	-1	-1	-2	-3	-4	-6	-8	-11
SurfaceMod	0.00003 (4)	0.0001	0.0003	0.001	0.003	0.01	0.03	0.09
Min Depth	0	0	0	0	0	0	0	0
Max Depth	16	75	172	310	466	606	727	800

Surface Hydrosphere can be lakes or rivers

To determine the kind test $y(1 - 100) w / (z) = \text{Hydro Area} * 0.5$

if $y \leq z$: lakes else rivers

Additional Modifier:

Surface Hydro Modifier (lake/river) = $3\text{SQRT}(\text{Hydro Area}) - 2$ or:
 area% 1-3 = -1 4-14 = 0 15-42 = +1 43-91 = +2 92-100 = +3

rivers: Region Relief: Plain 0 Broken +1 Mountainous 0
 lakes: Region Relief: Plain 0 Broken 0 Mountainous -1
 gravity 0 - 0.15 +3 0.15-0.3 +2 0.3-0.6 +1 >0.6 0

Rivers: pros = no limit capacity of use (only a flow cap) cons = one infrastructure can affect the "aval" flow

Flow (m3/h / Infra Level) = Flow Base * xFlow Multiplier * 3600
 StM in meters(a) = (StM / SurfReg divider) * 10^6
 max extractable volume(z) = 0
 extractable volume left = z
 spot size (in IL) = $\text{SQRT}(a) \text{ int}()$
 used spot size = 0

Lakes: pros = big reservoir tu pump cons = limited (in relative terms) capacity + no flow for specific uses

min depth(w) = 0
 usable depth(y) = rand(MaxD) y is in meters

StM in meters(a) = StM * 10^6
 max extractable volume(z) = (a * SurfaceMod) * y in cubic meters rto -3
 extractable volume left = z
 spot size (in IL) = SQRT(a) int()
 used spot size = 0

Ore Deposit Size Spot Rarity	Minimal	Tiny	Small	Modest	Average	Significant	Vast	Immense
Rare	1 - 4	5 - 7	8 - 9	10	x	x	x	x
Uncommon	1 - 2	3 - 5	6 - 8	9	10	x	x	x
Present	1	2	3 - 4	5 - 7	8 - 9	10	x	x
Common	x	1	2	3 - 4	5 - 7	8 - 9	10	x
Abundant	x	x	x	1	2	3 - 5	6 - 8	9 - 10
Rich	x	x	x	x	1	2	3 - 6	7 - 10
SpotDiffStack	-1	-1	-1	-1	-2	-3	-4	-6
SurfaceMod	0.00000000 001 (10)	0.00000000 01 (9)	0.00000001 (7)	0.0000001 (6)	0.00001 (4)	0.0001 (3)	0.01	0.1
Min Depth	0	0	67	200	399	668	968	1186
Max Depth	448	763	1221	1831	2564	3333	4000	4400

min = { max / [10 - (SQRT(max) / 10)] } - 120

Additional Modifier:

Region Relief: Plain 0 Broken 0 Mountainous -1

minmax depth(u) = MaxD - MinD
 minmaxtoerance(v) = u * 0.1
 min depth(w) = rand((u - v)) + MinD
 usable depth(y) = rand((MaxD - w)) y is in meters

StM in meters(a) = StM * 10^6
 max extractable volume(z) = (a * SurfaceMod) * y in cubic meters rto -3
 extractable volume left = z
 spot size (in IL) = SQRT(a) int()
 used spot size = 0

Aquifer Size Spot Rarity	Minimal	Tiny	Small	Modest	Average	Significant	Vast	Immense
Rare	1 - 4	5 - 7	8 - 9	10	x	x	x	x
Uncommon	1 - 2	3 - 5	6 - 8	9	10	x	x	x
Present	1	2	3 - 4	5 - 7	8 - 9	10	x	x
Common	x	1	2	3 - 4	5 - 7	8 - 9	10	x
Abundant	x	x	x	1	2	3 - 5	6 - 8	9 - 10
Rich	x	x	x	x	1	2	3 - 6	7 - 10
SpotDiffStack	0	-1	-2	-4	-5	-7	-8	-10
SurfaceMod	0.00000000 3 (8)	0.00000003 (7)	0.0000003 (6)	0.000003 (5)	0.00003 (4)	0.0003 (3)	0.003	0.03
MinDepth	3	5	8	10	12	13	14	15
MaxDepth	30	120	300	470	620	760	890	1000

min = (max / sqrt(max)roundauto) / 2 no round

ALWAYS STORE THE TYPE OF LIQUID AQUIFER (because if hydro ice sheet/crust defines the underground liquid. and can be different for ice crust)

Additional Modifier:

Region Relief: Plain 0 Broken +1 Mountainous 0

aquifer modifier: if coast = +1 /surface hydro resource spot discovered = +1

$\text{minmax depth}(u) = \text{MaxD} - \text{MinD}$
 $\text{minmax toerance}(v) = u * 0.1$
 $\text{min depth}(w) = \text{rand}((u - v)) + \text{MinD}$
 $\text{usable depth}(y) = \text{rand}((\text{MaxD} - w))$ y is in meters

$\text{StM in meters}(a) = \text{StM} * 10^6$
 $\text{max extractable volume}(z) = (a * \text{SurfaceMod}) * y$ in cubic meters rto -3
 $\text{extractable volume left} = z$
 $\text{spot size (in IL)} = \text{SQRT}(a) \text{int}()$
 $\text{used spot size} = 0$

: additionally to these data, one common data is calculated, it is the Main Quality (MQ):

Mean Quality (MQ) is calculated by taking the final quality score and cross it in the table below for the Mean Quality Range. After that a random value is generated by taking this range in account.

Quality	Gas	Surface Hydro Aquifer	Ore
F	10% - 35%	30% - 50%	1% - 13%
E	13% - 50%	40% - 60%	7% - 20%
D	19% - 60%	50% - 70%	7% - 26%
C	21% - 75%	60% - 80%	10% - 34%
B	27% - 85%	70% - 90%	12% - 40%
A	29% - 100%	80% - 100%	14% - 45%

MQ Coefficient= (MQ generated % * modTectonicActivity) / 100

MQ generated = rand (MQRange)

modTectonicActivity: modifier for regions with Volcanic land type and an orbital object's tectonic activity > hotspots + only for metallic ore and rare metals ore. for any other type of region and/or if the tectonic activity = hotspots and/or other resources, the mod = 1.

It increase the purity, of the surface exposed deposits of metal ores, into nearly pure form (when plastic, well less with plates tectonic)

Of course the exploitation in such region is as dangerous as it can be, even before to take into consideration the planet's ecosphere itself.

Tectonic Activity	modTectonicActiovit y
Plastic	* 2
Plate Tectonic	* 1.58333
Platelet Tectonic	* 1.16666
Extreme	* 0.74999

normally, extreme one shouldn't be available

: the SpotDiffStack of the resource spot is updated if discovered

* anything needing to be updated (the UI) is, and a message log entry is generated

4.4.4.Features & Artifacts Survey

4.4.5.Biological Survey