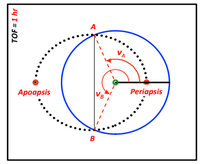
SUBORBITAL IMPRINT MATCHING

SUBORBITAL ANALYSIS: THE A-to-B PROBLEM IN PLANETARY SCIENCE

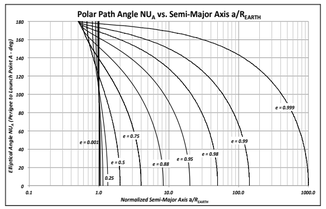
TIME OF FLIGHT (TOF): CORRELATING EJECTA & STREWN TO SOURCE

Derivations Within This SUBORBITAL ANALYSIS Are Based On The Simplified Two-Body Model Where The Satellite Is Assumed To Be Massless. System Mass Is Concentrated At The Center Of The Central Body, Which Is Also The Coordinate Origin Of The Body-Centered Inertial Frame. Higher Order Terms Are Neglected, Such A Planetary Oblateness, Lunar Gravity, Solar Pressure, Electro-Magnetic & Atmospheric Effects.

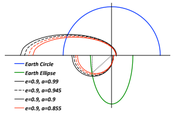
Basic Suborbital Trajectory: A-to-B Chord & Central Angles (Scaled To Earth's Gravity)



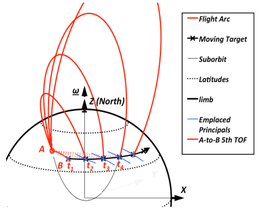
Suborbital Time Of Flight (TOF) Depends On Eccentricity "e" AND Semi-Major Axis "a" Instead of Semi-Major Axis Only as in FULL Orbits (Kepler's 3rd Law).



Normal and Oblique Plane Views: The b-Circle For TOF Calculation Per Kepler's 2nd Law: Constant Area Sweep Rate

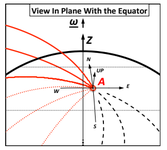


Infinite Different A-to-B Trajectories Exist, Each With A Different TOF Value, For A Rotating Planet. This Complicates Analysis.



The Oblique Plane View Makes The Orbit Into A Circle Of Radius = "b": b Is The Semi-Minor Axis, So That Calculating Swept Area Is Trivial

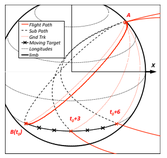
Infinite Trajectories Exist To Get From A-to-B: One Solution For Each Discrete TOF While B Rotates Through Inertial Space.

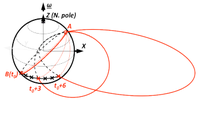


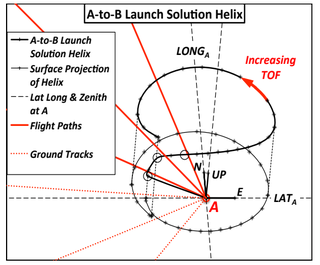
The Set Of All Solution Trajectories For A Given A-To-B Pair May Be Defined By The A-To-B Launch Solution Helix. This Useful Format Always Has Common Features From Bottom Up:

- *A Base Leg Starting At The Min TOF Solution Trajectory*
- *A Minimum KE Point Just Above Min TOF Point*
- *A Transition Or "Knee" where ΔEL Gives Way To ΔAZ*
- *An AZ Arc Which May Encircle 1, 2 or No Poles*
- *A "Day Later" Point On Approximately The Min TOF AZ*

The Min TOF Trajectory Is Defined By A Circular Orbit At Zero Altitude, Smooth Spherical Planet, No Atmosphere. The Launch Solution Helix Is Defined In The Local Topocentric (Earth-Fixed) Frame For Comparison To Lab Test Ejection Patterns.







The A-To-B Launch Solution Helix Is Defined By Kinetic Energy Launch Vectors in Azimuth (AZ), Elevation (EL), and Magnitude Normalized To Earth Escape KE Or EEKE.

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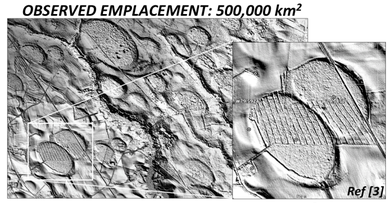
1-4 NOVEMBER GSA 2015 Baltimore, Maryland, USA

BALLISTIC EMPLACEMENT: A SNAPSHOT OF THE TRANSPORT PROCESS

1-4 NOVEMBER GSA 2015 Baltimore, Maryland, USA

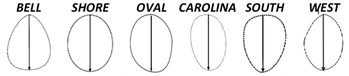
1 *A Suspected Ejecta Emplacement Has No Associated Impact Structure. Details Imprinted Within The Subcontinental Stratigraphic Sand Unit Cry Out For Adequate Interpretation. Previous Workers Have Failed To Explain The Combined Set Of Observable Details.*

OBSERVED EMPLACEMENT: 500,000 km²



2 *45,000+ Ovoid Depressions In A ~500,000 km² Depositional Unfossiliferous[1] Sand Unit: Quantified By Cintos.org, All 45,000 Cases Were Deposited By A Single Process [1] & Fit Just Six (6) "Archetype" Shapes.*

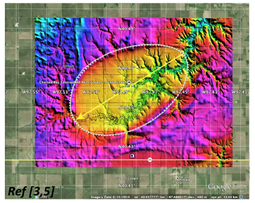
BELL SHORE OVAL CAROLINA SOUTH WEST



All Carolina Bay (Ovoid Depression) Imagery Provided By Cintos.org And M. Davias [2,3], Who Measured LiDAR Imagery Of 45,000+ Of Them. Adjacent Overprinting In Some Pairs Of Depressions Indicate Suborbital Transport [4]....

3 *The Ovoid Alignment In The Sand Unit Is Rigidly Systematic By Lat [2], Bearings Geographically Convergent. Is This A Clue To The Transport & Emplacement Processes? Location Of Origin? Age?*

NEBRASKA: 5 km OVOID DEPRESSION

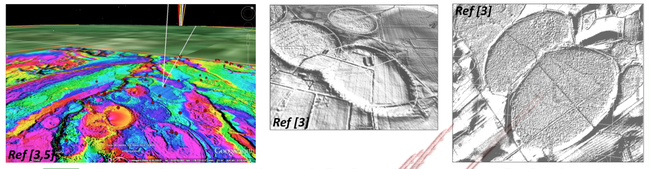


4 *The Sand Is Lacking Any & All Evidence Of Terrestrial Transport Process [1], Having Angular To Subangular Grain Texture, Monotonous Bulk Uniformity, Opaque White Appearance And Extensive Internal Fracturing.*

5 *The Six Archetypes Are Identical To Ballistic Missile Targeting Diagrams, Strongly Indicating A Suborbital Governor Of The Unit Transport & Emplacement Processes. They Are Gravitational Convolutions Of Launch Vectors With Slight Velocity Variation Across A Conical Profile, Exactly Like Suborbital Ballistic Probability Profiles. This Is A Ballistic Emplacement.*

6 *"Suborbital Obstruction Shadowing" [4,5] Is A Hypersonic Aerodynamic Process which Imprints A Flux Variation [6] Of Comminuted Target Mass In The Wake Of A Larger, Slower Blunt Body. The Larger Body, Or "Obstruction" Deflects The Entrained Aggregate Radially Outward From The Flow Axis Through Hypersonic Bow Shock. The Cone-Shaped Wake Becomes Imprinted With Increased Aggregate Flux Around Its Perimeter And Reduced Flux In Its Interior. These Flux Variations Represent "Seeds" Of Later Surface Emplacements: A Rim Around A Depression In A Unit Of Depositional Bedding.*

7 *"Suborbital Convolution" [5] Happens As The Radial Displacement From The Bow Shock Induces Velocity Variations Around The Conical Perimeter Of The Wake. The Velocity Variations Cause Dispersion During Time Of Flight (TOF) As ΔV Integrates To ΔR. The Dispersion Is Controlled By Suborbital Mechanics, Extractable Through Basic Modeling With Careful Choice Of Parameters.*



8 *As The Aggregate Descends To The Surface In Varying Flux, the Imprinted Flow Becomes Emplaced As A Robust Stratigraphic Unit Upon The Antecedent Terrain, With Angular Grains Interlocking. The Expression Appears As Uniquely Shaped Oval Voids With Rims In The Sand Unit. Overprinting Between Adjacent Bays (i.e. Obstruction Shadowing [4] Of Proximal Bodies [5,6]) Is Also Present.*

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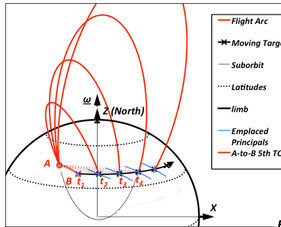
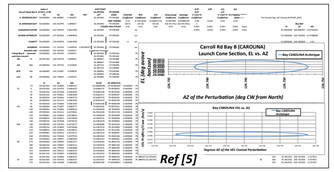
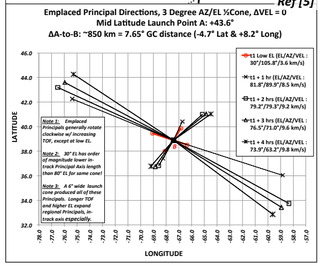
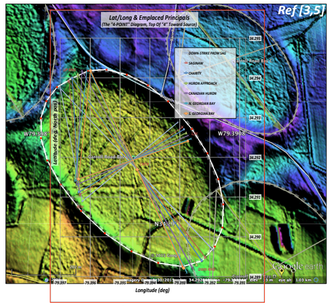
BALLISTIC EMPLACEMENT: A SNAPSHOT OF THE TRANSPORT PROCESS



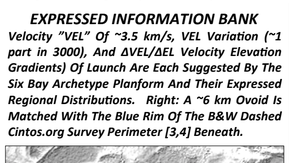






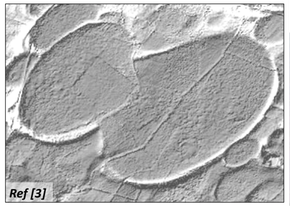
CONICAL PERTURBATION AND ORBIT OUTPUT OVERLAY

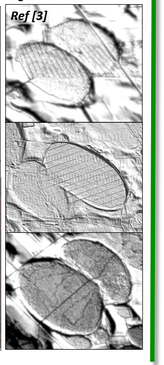
A Simple Cone Of Launch Vectors With Vertex At Some Proposed Launch Point Is Used To Generate A Conical Set of Suborbital Ballistic Trajectories. The Cone Represents An Obstruction to Impact Detonation Outflow From That Vertex (i.e. Spherical Adiabatic Expansion With Entrained Aggregate Ejecta). The Outflow Velocity Is Altered By Bow Shock Around An Obstruction During Ascent [4]. When The Trajectories Descend To Emplacement, They No Longer Have The Same Cross Section As Imprinted by The Bow Shock. Orbital Dynamics Imparts Added Features During Suborbital Flight: A Suborbital Transport Imprint. Many Different Signatures Within The (Tens Of Thousands Of) Shapes Of This Expressed Emplacement Allow Decoding Of Suborbital Transport. EL-AZ-VEL & Region Of Launch, ΔVEL/ΔEL Flow Velocity Gradient During Ascent, Degree Of Volatile Surface Involvement And Total Energy May All Be Estimated. A Big Event Took Place....



EXPRESSED INFORMATION BANK

Velocity "VEL" Of ~3.5 km/s, VEL Variation (~1 part in 3000), And ΔVEL/ΔEL Velocity Elevation Gradients) Of Launch Are Each Suggested By The Six Bay Archetype Planform And Their Expressed Regional Distributions. Right: A ~6 km Ovoid Is Matched With The Blue Rim Of The B&W Dashed Cintos.org Survey Perimeter [3,4] Beneath.





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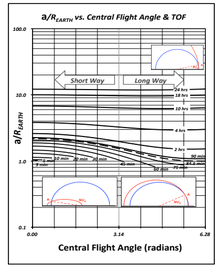
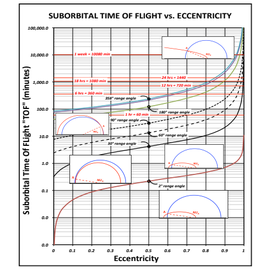
SUBORBITAL ANALYSIS: THE A-to-B PROBLEM IN PLANETARY SCIENCE

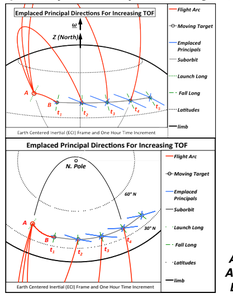
TIME OF FLIGHT (TOF): CORRELATING EJECTA & STREWN TO SOURCE

Because So Many Trajectories Are Possible For Every A-to-B Pair, We Need Perspective On How Suborbital Analysis May Help Correlate Both Regional And Global Strewn & Ejecta. Two Master Plots Are Very Helpful For Such Perspective, Allowing Quick Reference For Most Related Problems. On The Left, "Iso-TOF" Contours Are Shown Vs. Central Flight Angle & Normalized Semi-Major Axis. On The Right, Central Flight Angle Contours Are Shown Vs. Eccentricity & TOF.



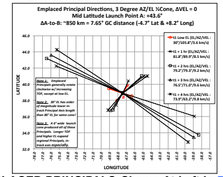


REGIONAL EXAMPLE: *Since The Launch Solution Helix Has A Fairly Vertical Leg For Close A-To-B Range, Emplaced Principal Clocking Stays Relatively Constant For Elevations Below The Knee Of The Helix, While Emplaced In-Track Length Increases With Elevation. This Pronounced Separation Of Effects Allows Range-&-Radial Source Location For Repetitive Emplaced Morphometry That Has Systematic Alignment By Geographic Location (i.e. The Carolina Bays).*



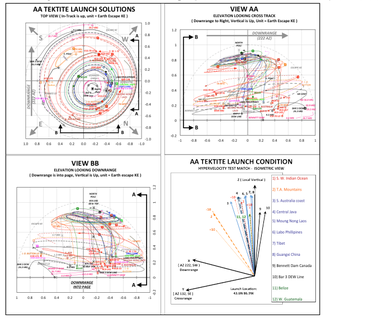
EMPLACED PRINCIPAL DIRECTIONS

Infinite A-to-B Trajectories Yield A Continua Of Downrange & Cross-Range Principals At Point B: Different EMPLACED PRINCIPALS For Each TOF.



EMPLACED PRINCIPALS *Shown At Left In Blue & Above In Red & Black. At Launch Elevations Near Or Above The "Knee" Of The Helix, The In-Track Principal Extends Radically (Black) Vs. Below The Knee (Red).*

GLOBAL EXAMPLE: *For Strewn Distribution, Launch Solution Helices Of Each Fall Site May Be Collated In KE-Space For Any Possible Launch Point A, And The Group Compared To Hyper-velocity Test Results For Ejection Trends Matching Specific Test Conditions (i.e. Volatiles, etc.)*



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