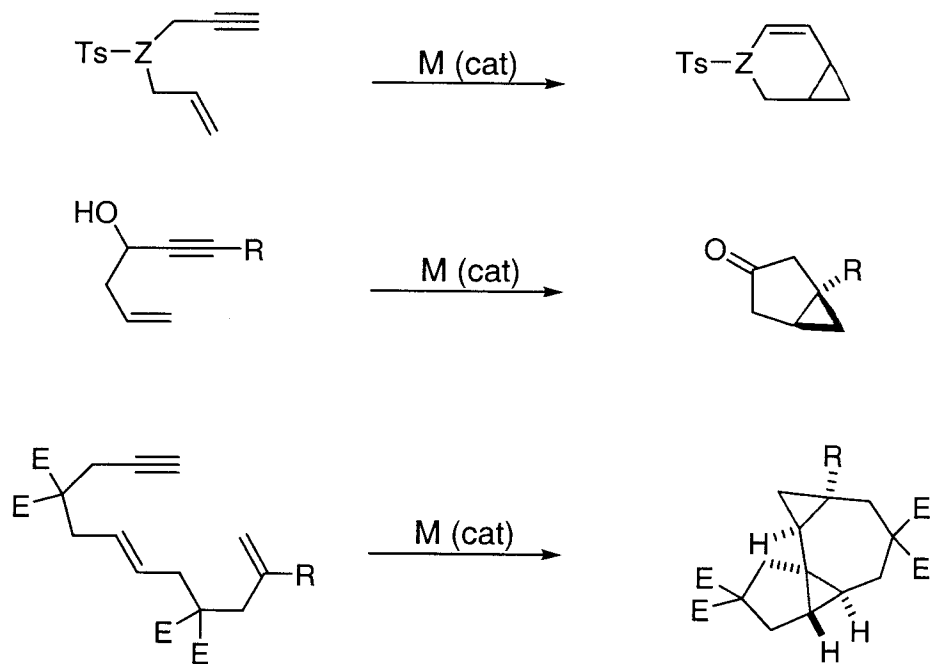
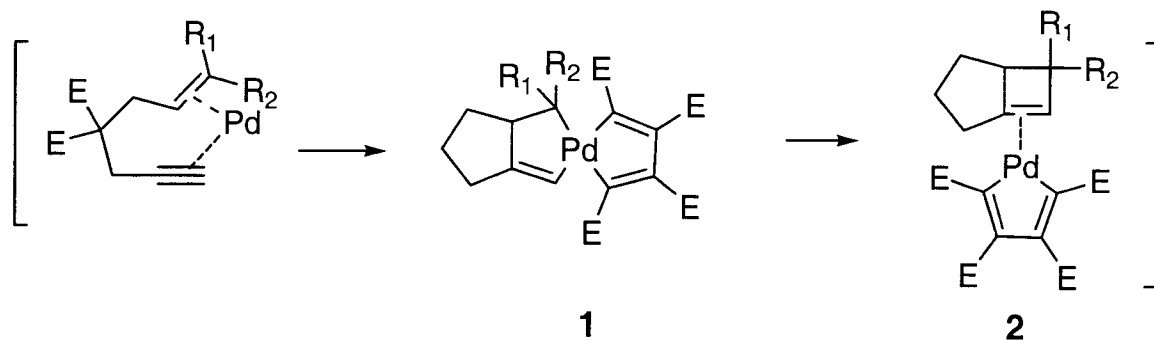
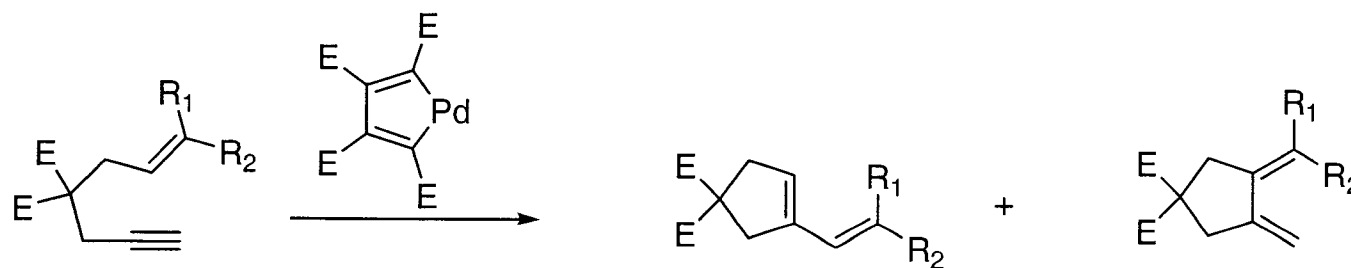


Platinum-Catalyzed Skeletal Rearrangements of Enynes: a New Route to Cyclopropane Derivatives



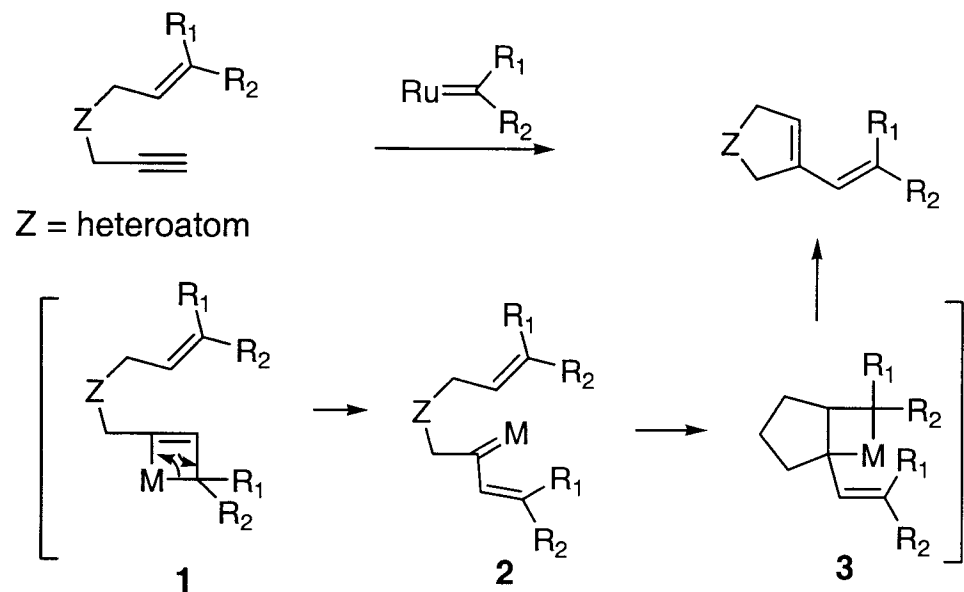
Tommy Bui (7/19/05)

Transition Metal-Catalyzed Skeletal Rearrangements of Enynes: Background



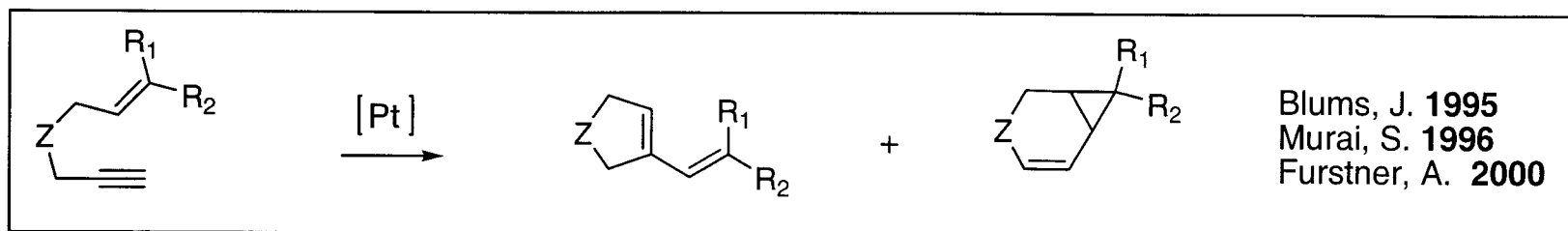
Trost, B. M. et al. *J. Am. Chem. Soc.* **1988**, 110, 1636
Trost, B.M. *Acc.Chem.Res.* **1990**, 23, 34
Trost, B. M. et al. *J. Am. Chem. Soc.* **1991**, 113, 1850

Transition Metal-Catalyzed Skeletal Rearrangements of Enynes: Background

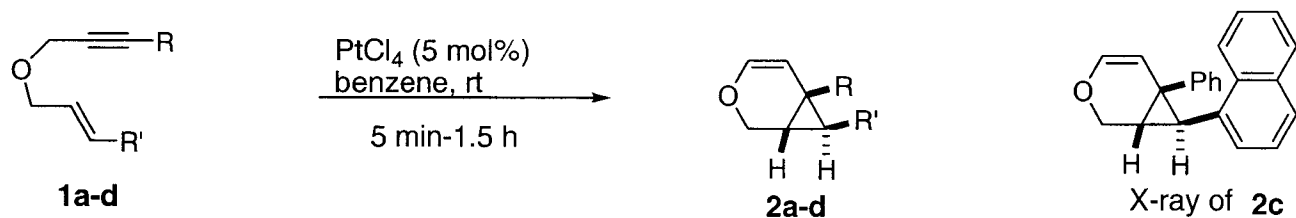


Enyne metathesis

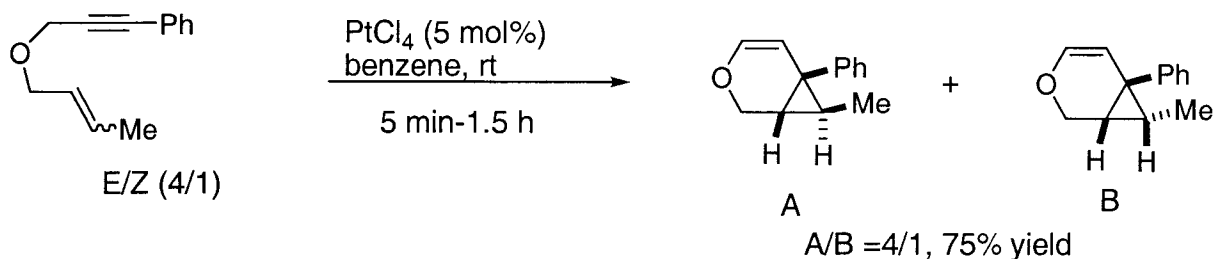
Mori, M. et al. *Synlett*, **1994**, 1020



Initial Finding on Platinum-Catalyzed Skeletal Rearrangements

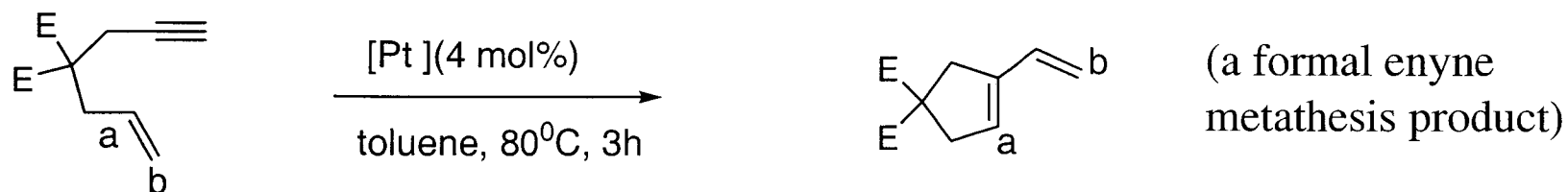


	R	R'	Yield (%)
a	Ph	H	20
b	Ph	Ph	97
c	Ph	1-naphtyl	28
d	Me	Ph	27



The reaction general gives variable yields.

Platinum-Catalyzed Skeletal rearrangements: Early Work



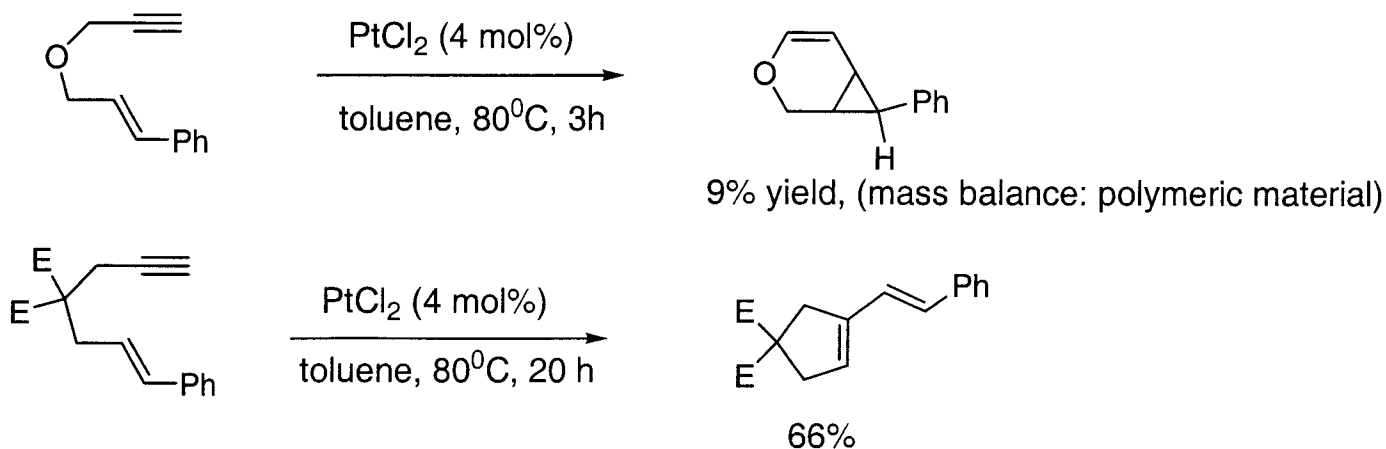
Two active platinum complexes: $PtCl_2$ (86%) $PtCl_4$ (79%)

$PtCl_2(PPh_3)_2$, $PtCl_2(COD)$, $Pt(SPh)_2$ no catalytic activity

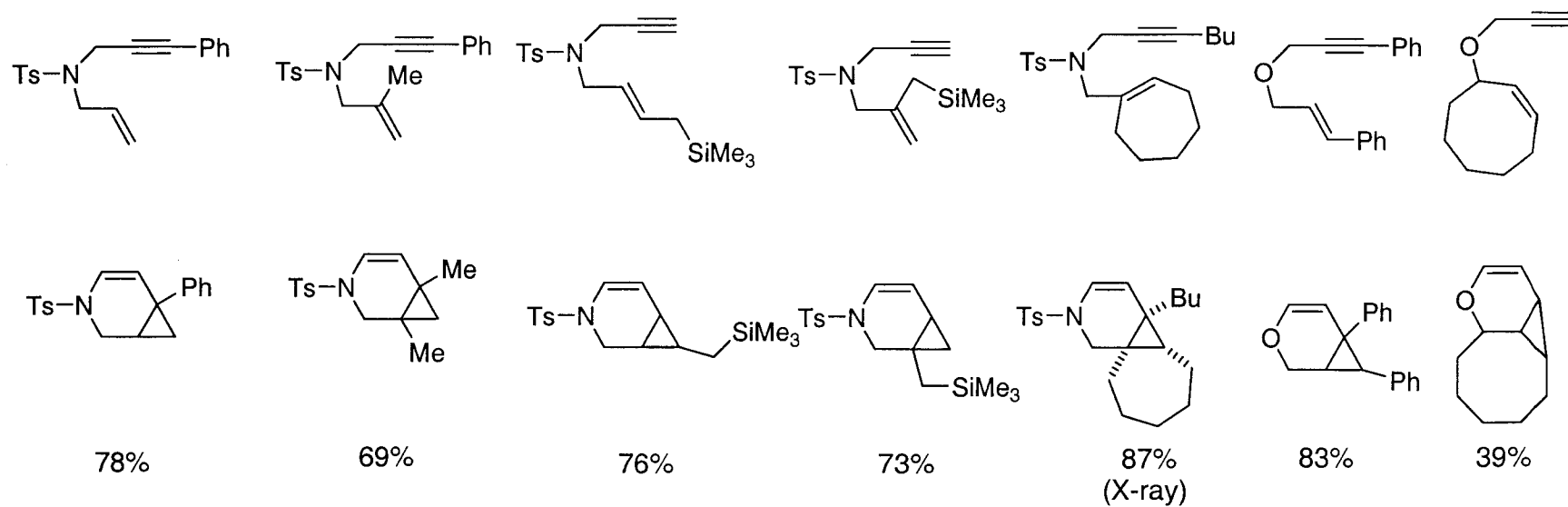
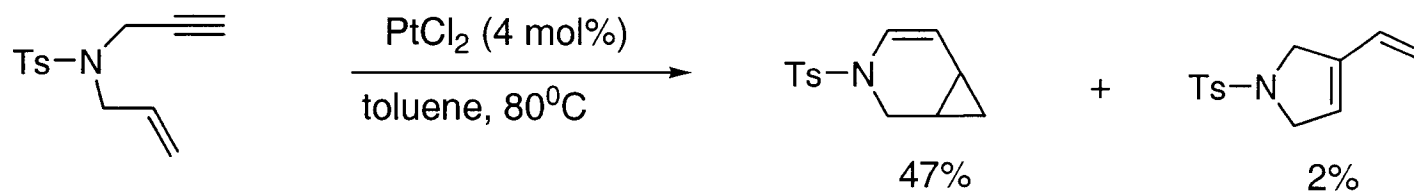
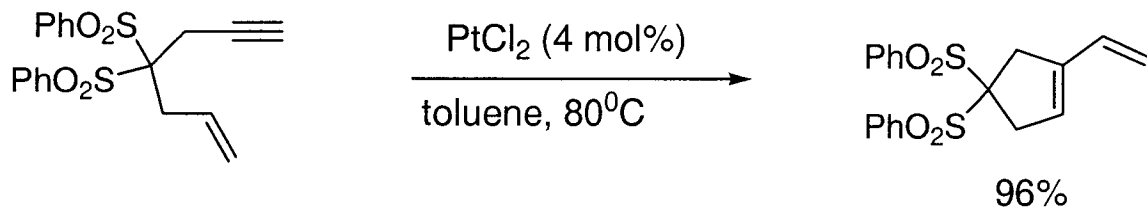
PtI_2 (poor solubility)

E = COOEt

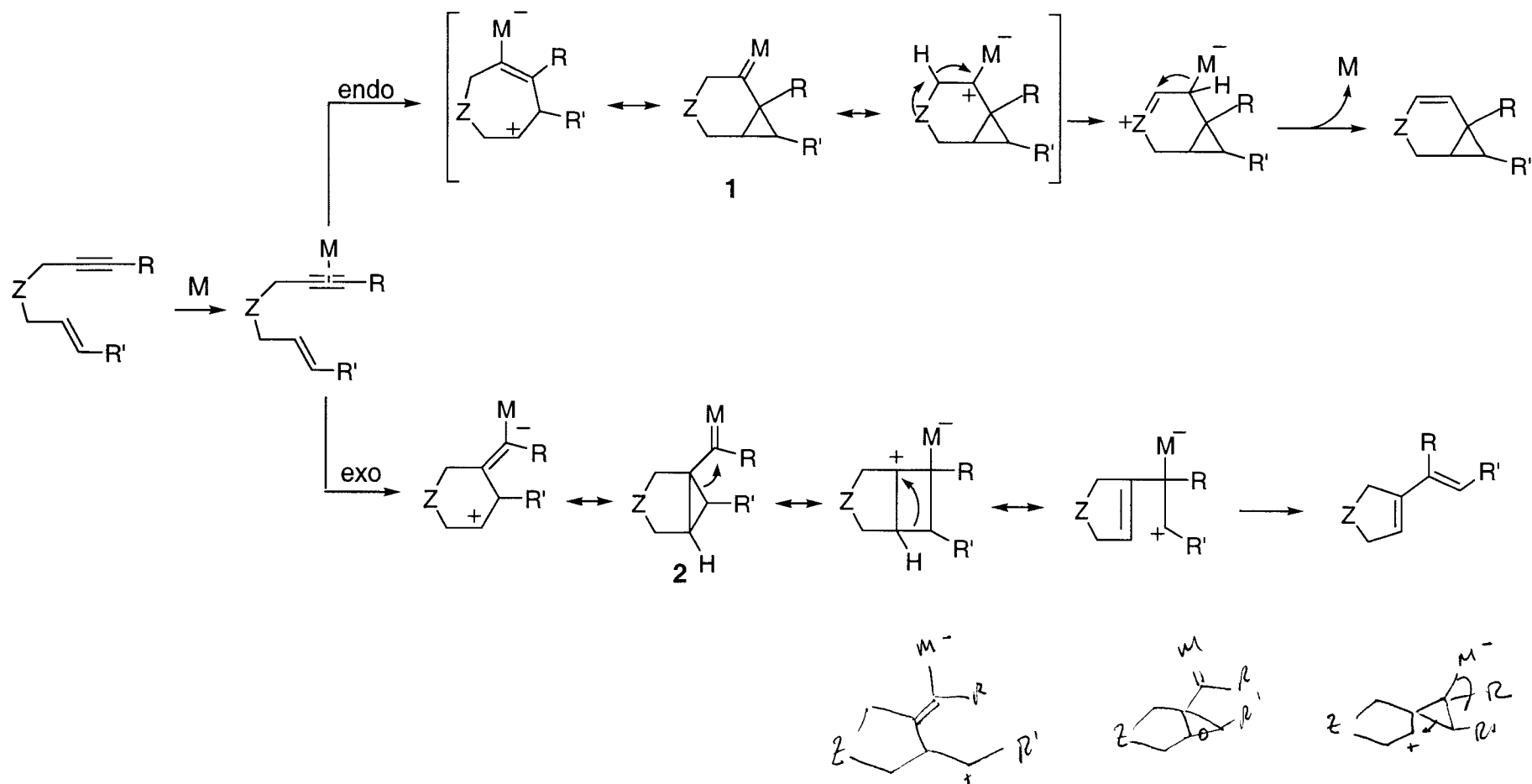
Chloride as a ligand is essential for the reaction to proceed.



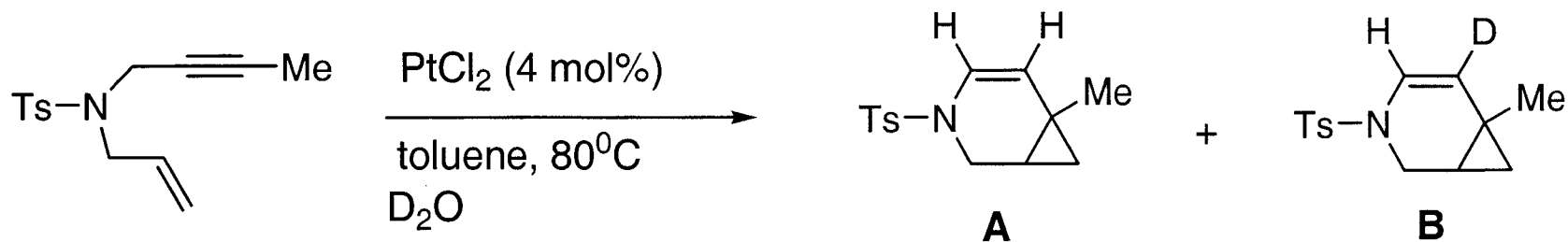
Carbon Versus Heteroatom Containing Tethers



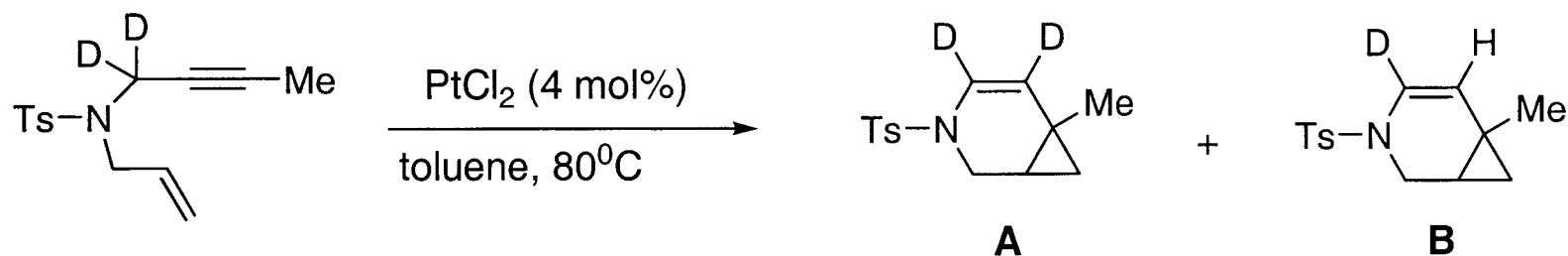
Proposed Mechanism



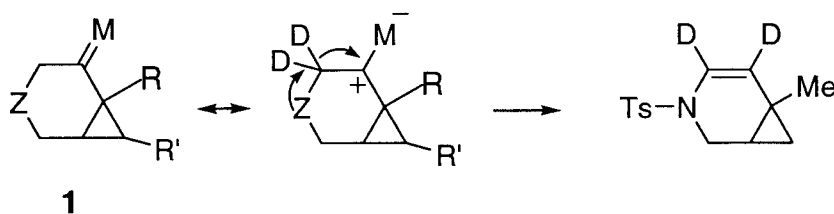
Deuterium Labelling Experiments



$$A/B = 3/1$$

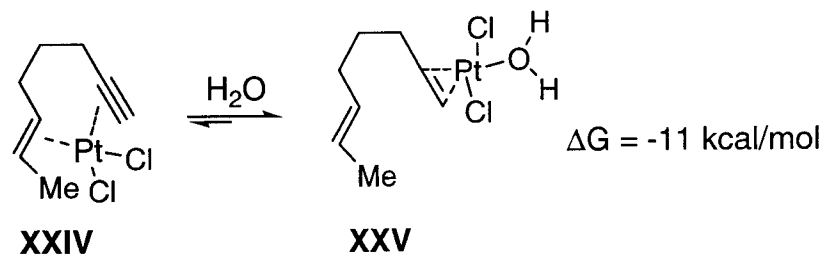
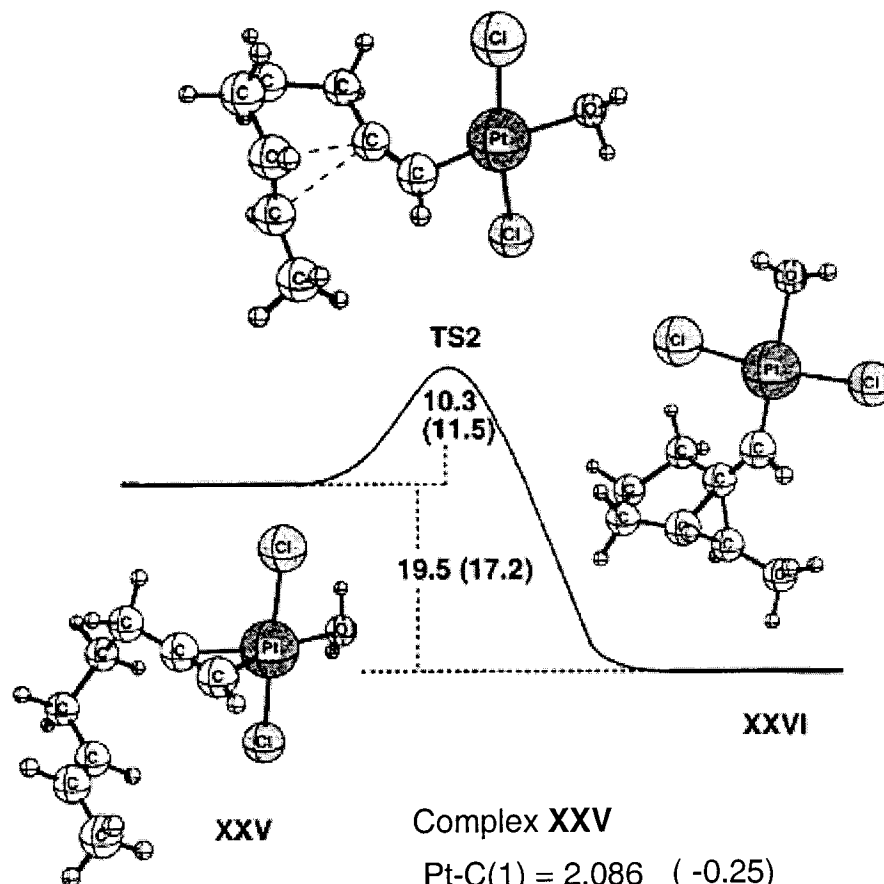
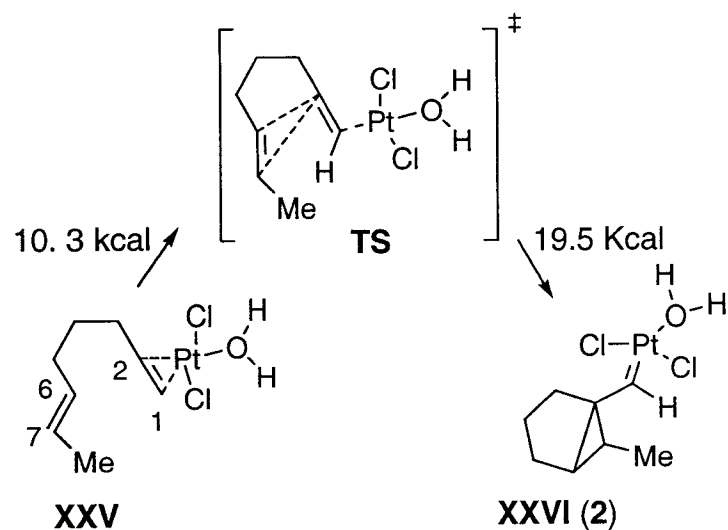


$$A/B = 3/1$$



Intermediate 1 is carbenoid in nature and stabilizes preferentially by 1,2 H shift.

Computational Studies



Complex XXV

Pt-C(1) = 2.086 (-0.25)

Pt-C(2) = 2.195 (+0.05)

TS

C2-C6 = 2.422 C1 (0-.036)

C2-C7 = 2.527 C2(+0.15)

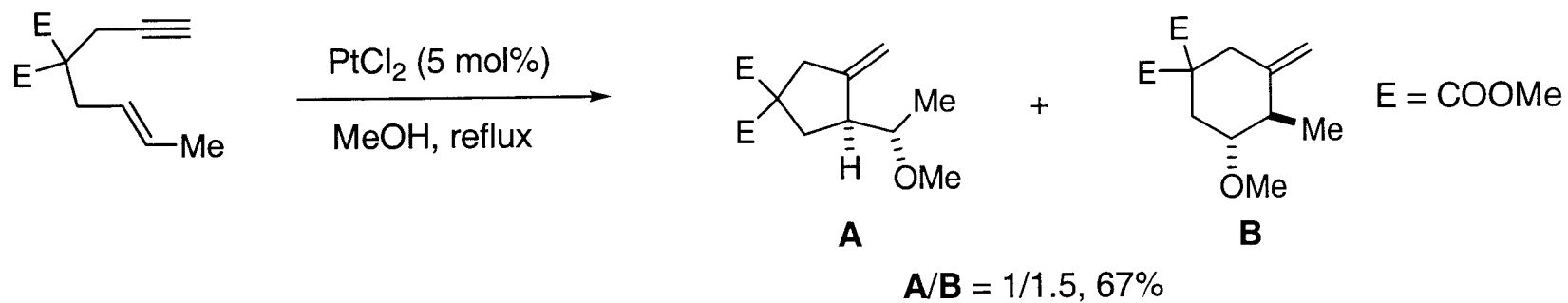
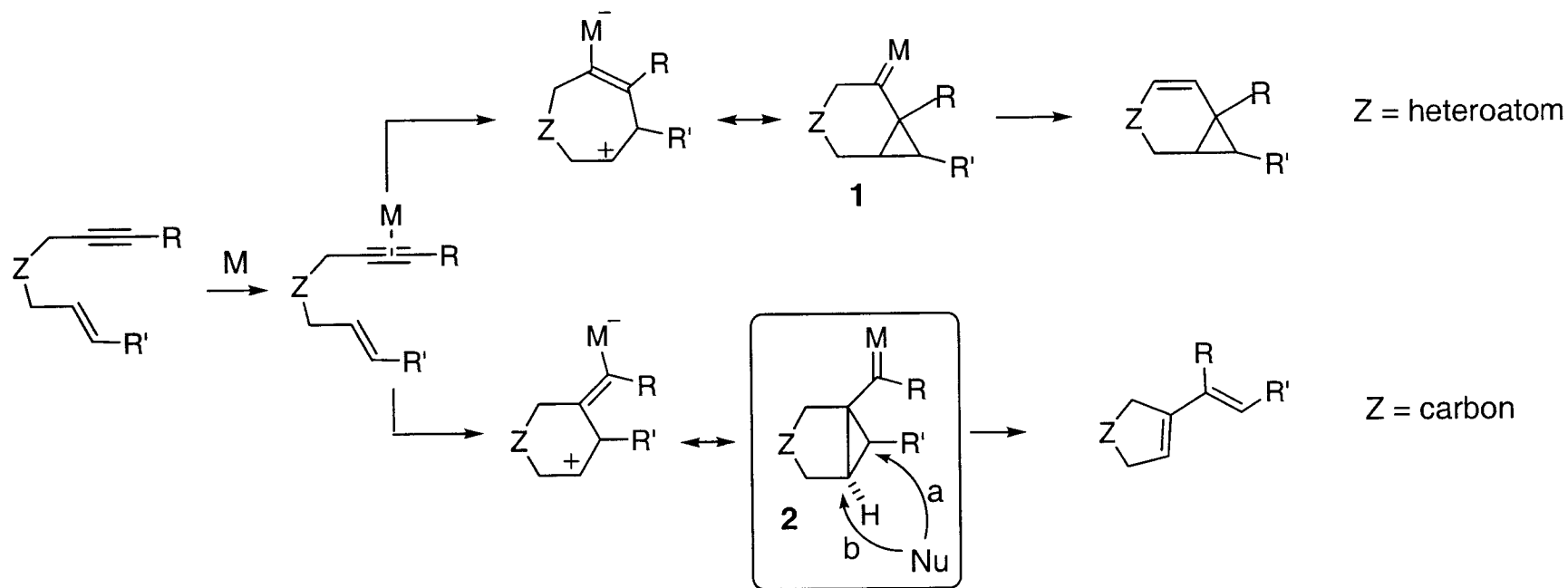
Pt-(C2) = 2.681 (elongation)

Complex XXVI

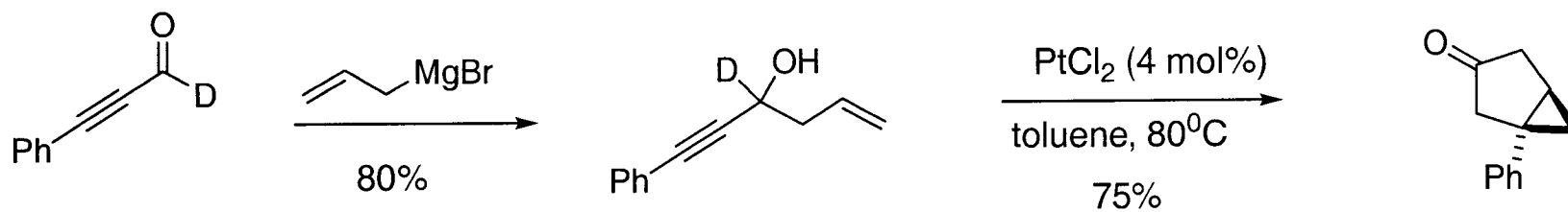
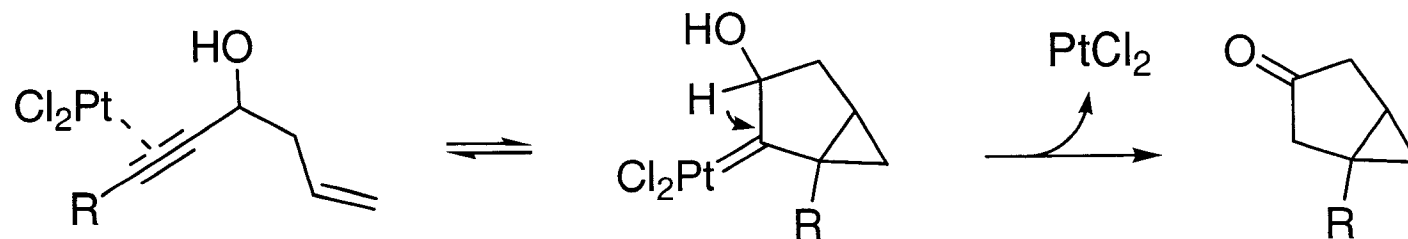
Pt-C = 1.881

dihedral angles Cl-Pt-C-H = 53-57°
(not coplanar)

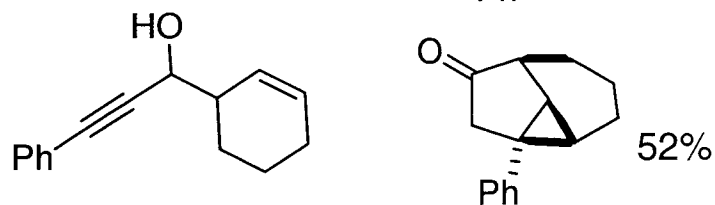
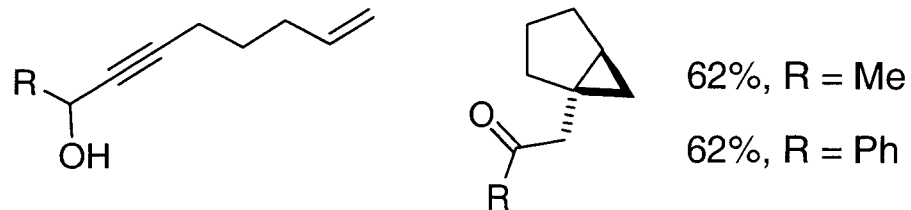
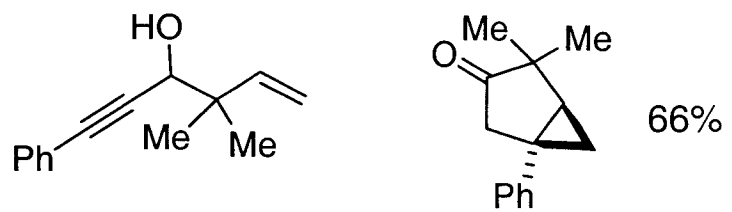
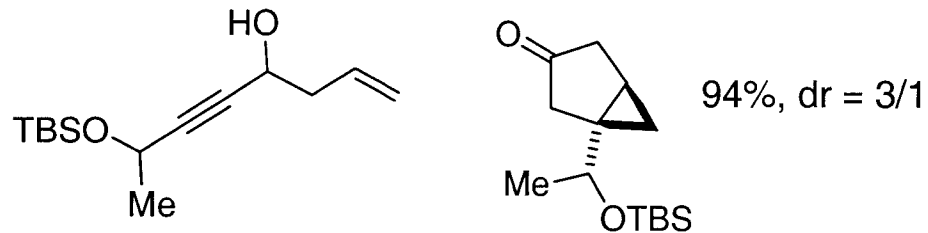
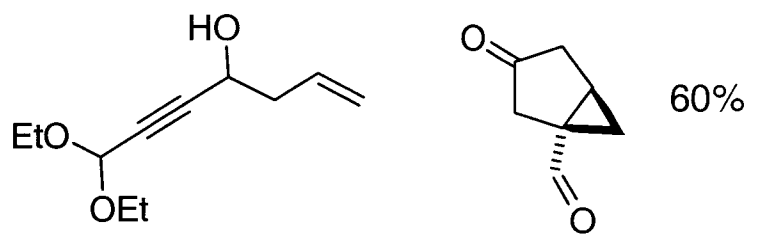
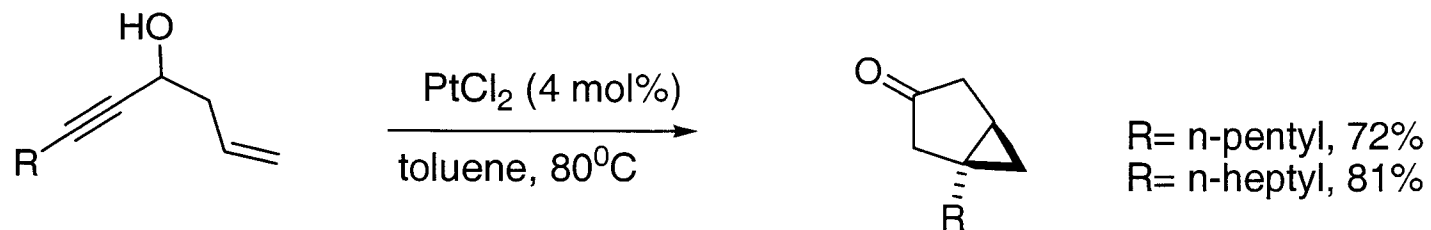
Trapping of the Bicyclic Cyclopropyl Intermediate



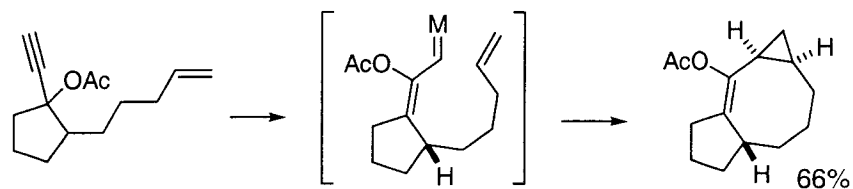
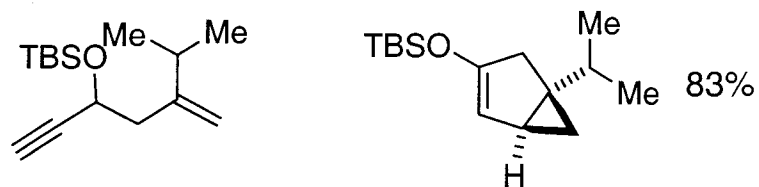
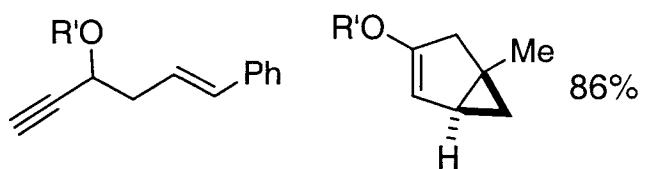
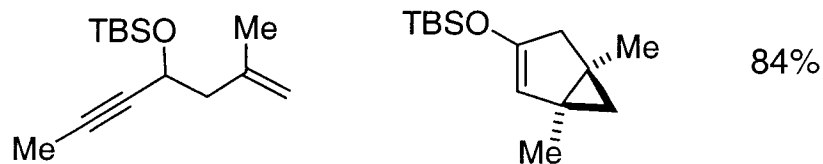
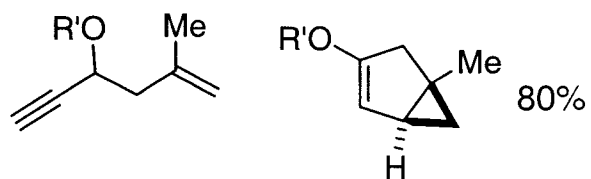
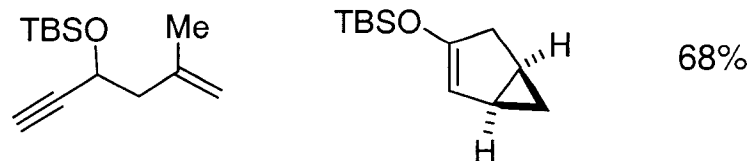
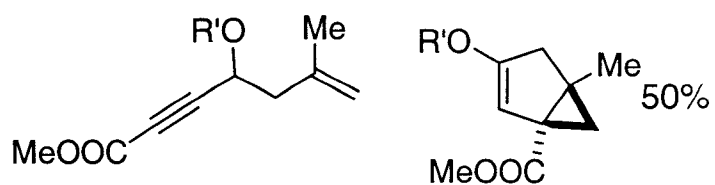
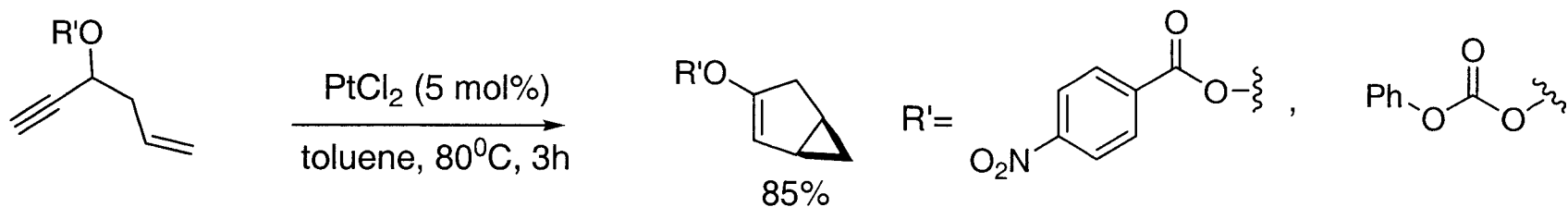
Taking Advantage of 1,2 Hydrogen Shift



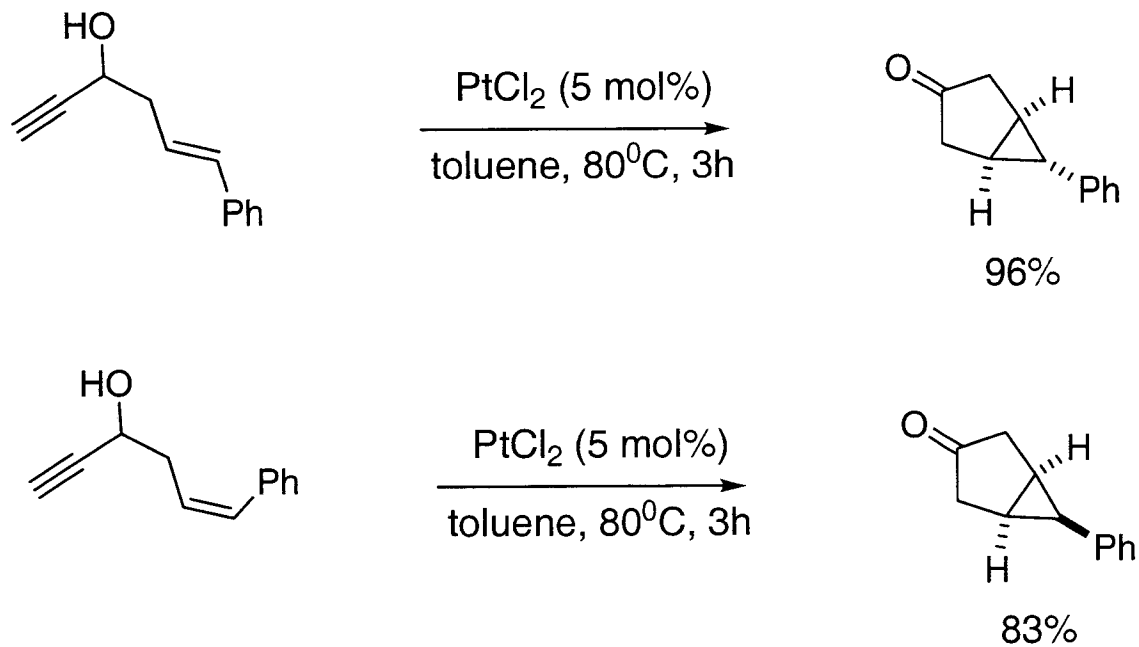
Scope of Cycloisomerization: Hydroxylated Enynes



Hydroxy-Protected Enynes

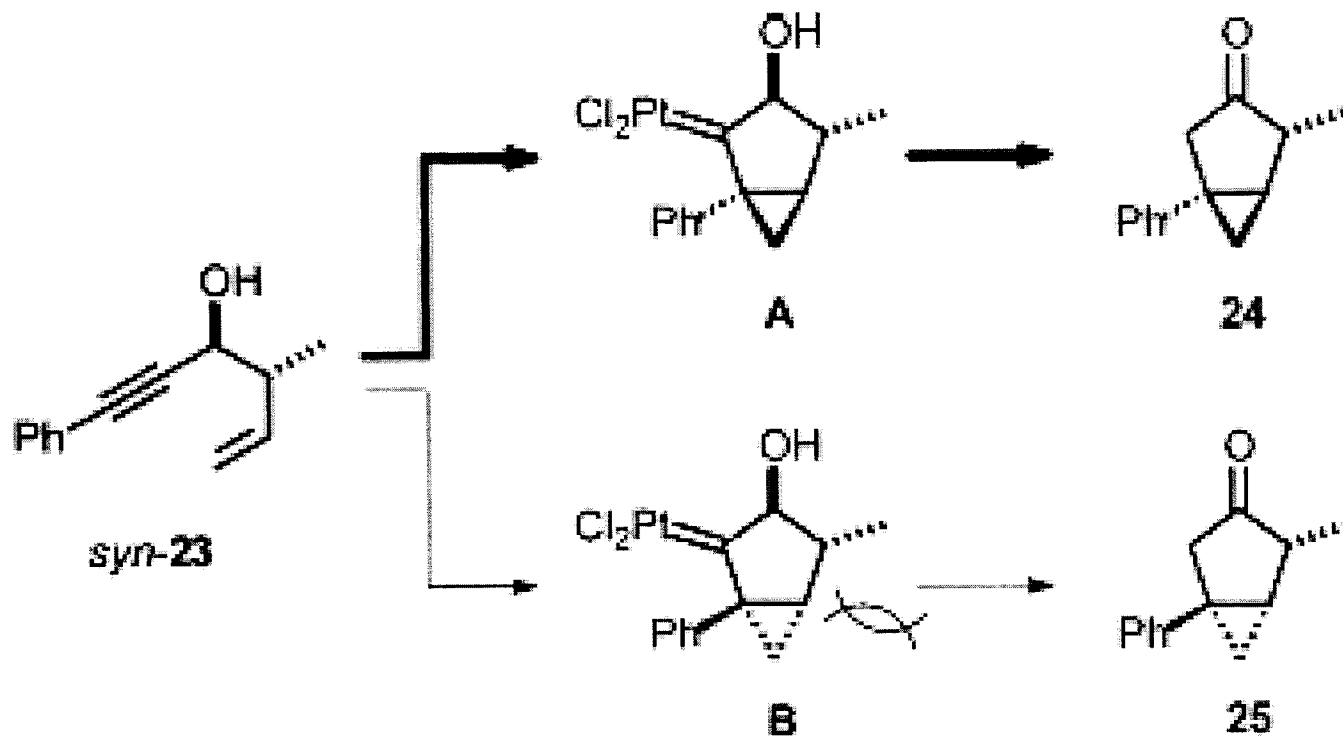


Enynes with Geometrically Defined Alkenes



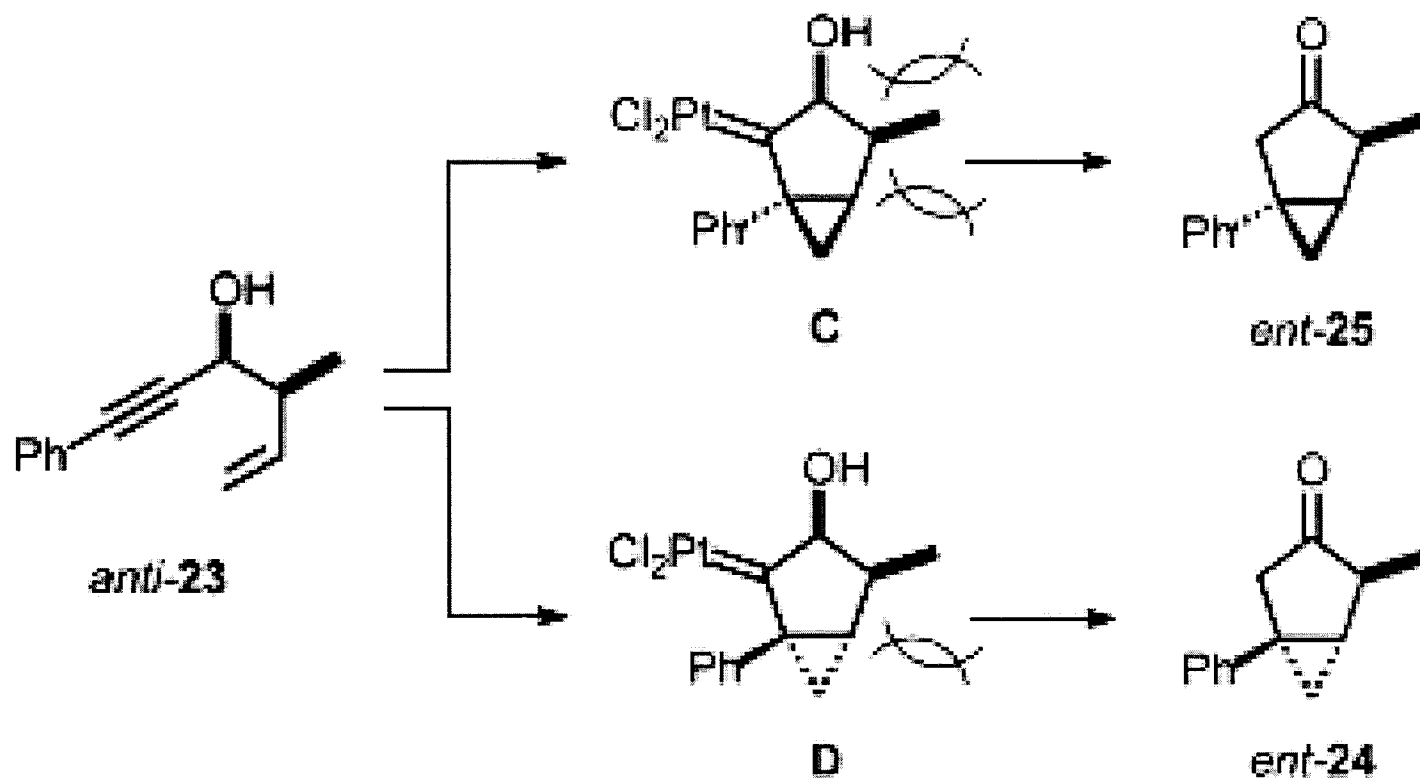
The reaction is stereospecific.

Chiral Hydroxylated Enynes



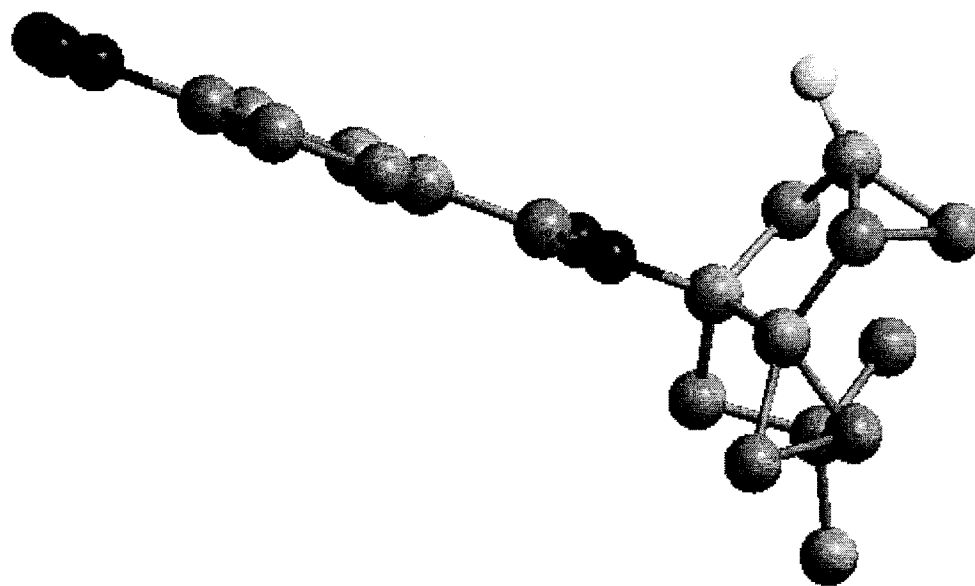
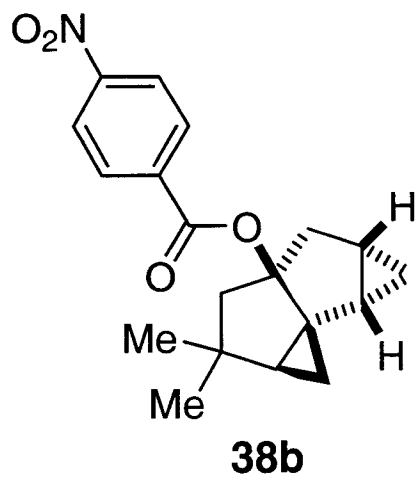
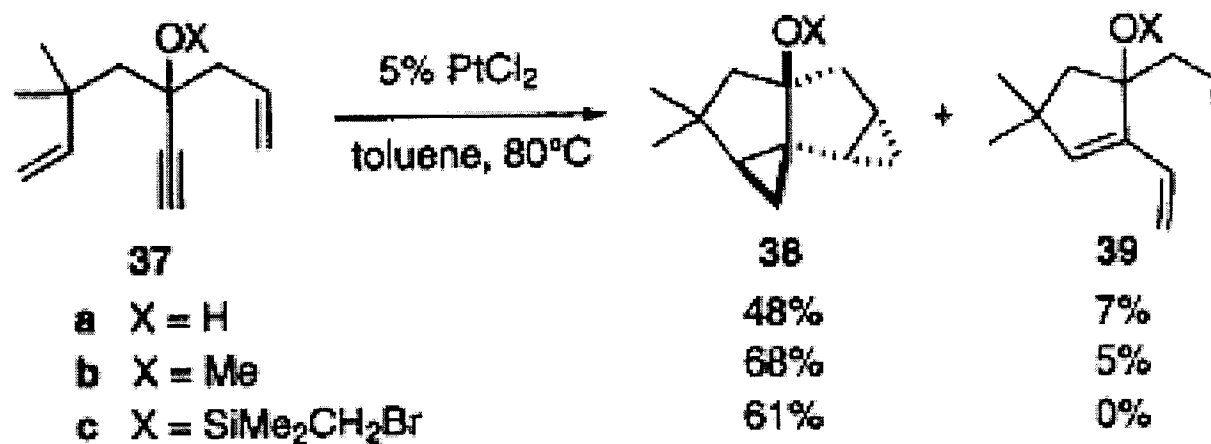
$dr = 24/25 = 4.3/1$, 65% yield
24, 92% ee and **25**, 89% ee

Scope of Cycloisomerization: Chiral Hydroxylated Enynes

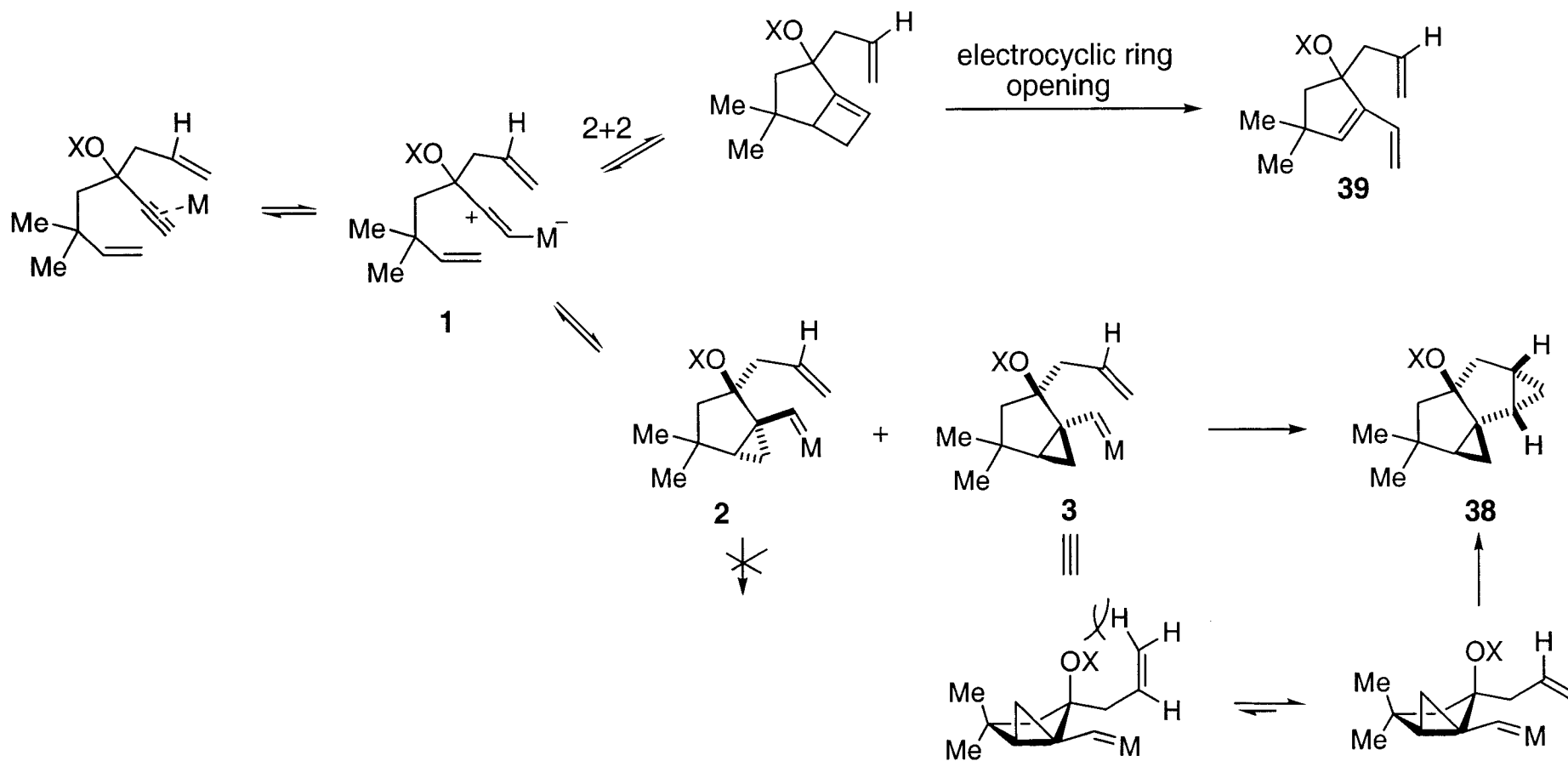


dr = *ent*-24/*ent*-25 = 1.5/1, 63% yield
ent-24, 78% ee and *ent*-25, 87% ee

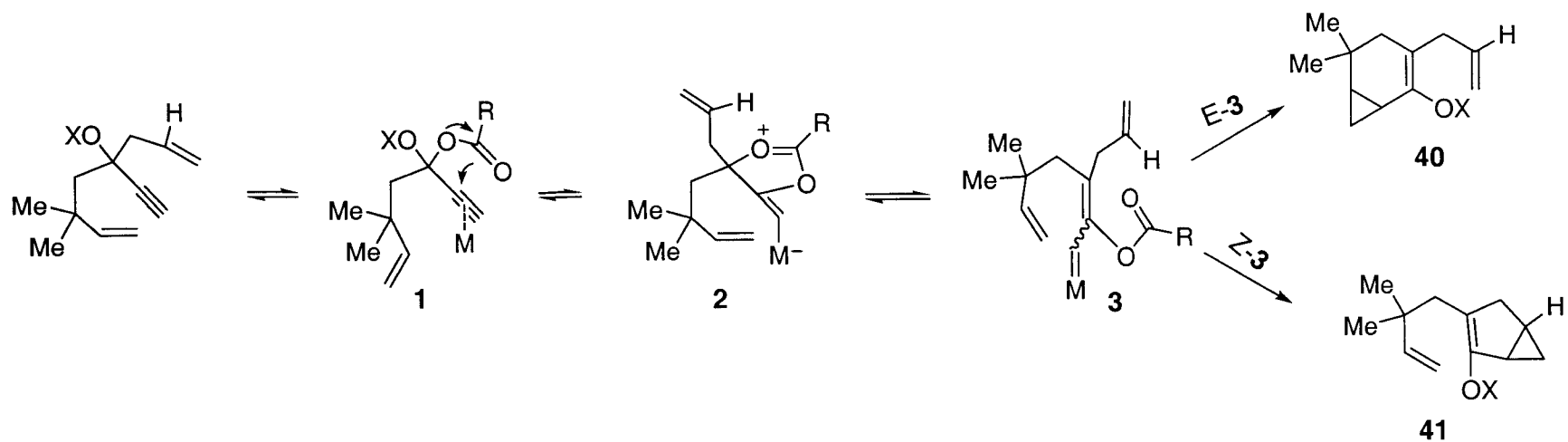
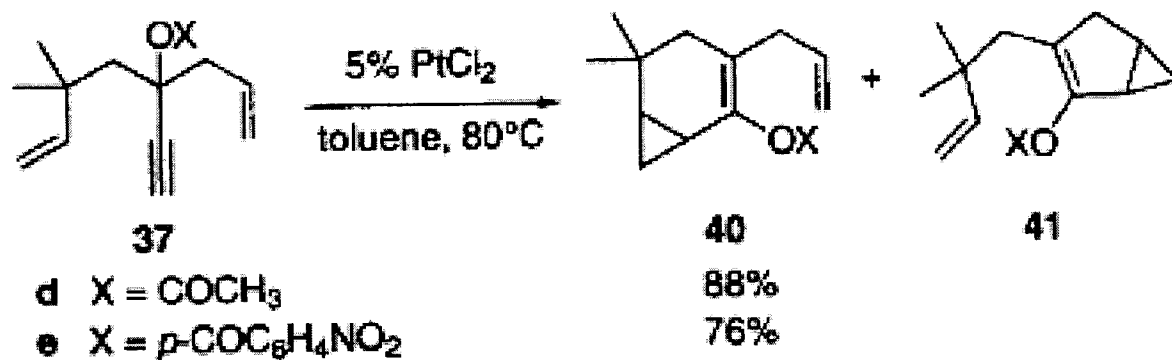
Scope of Cycloisomerization: Diene-yne



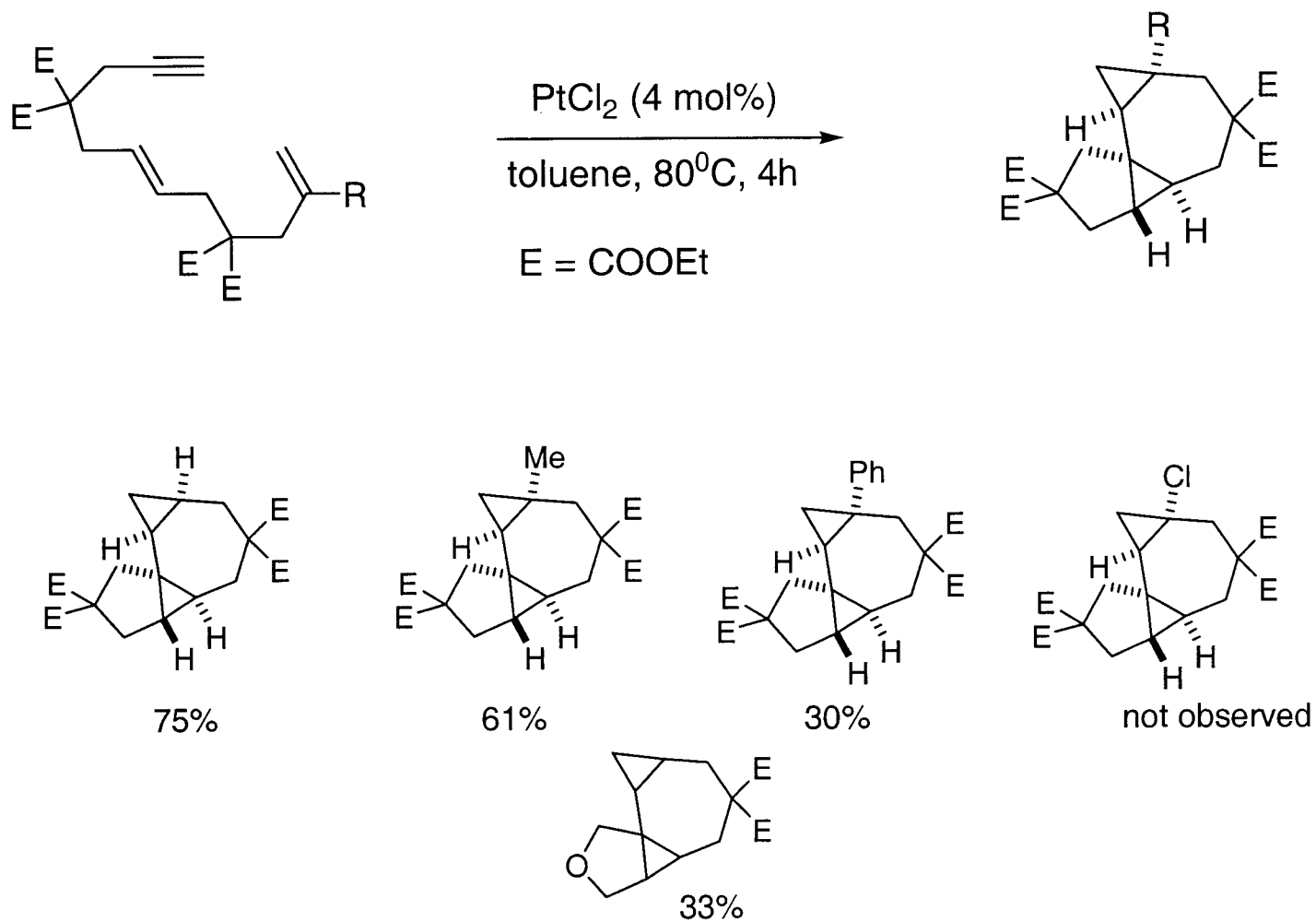
Diene-yne: Mechanism for Product Formation



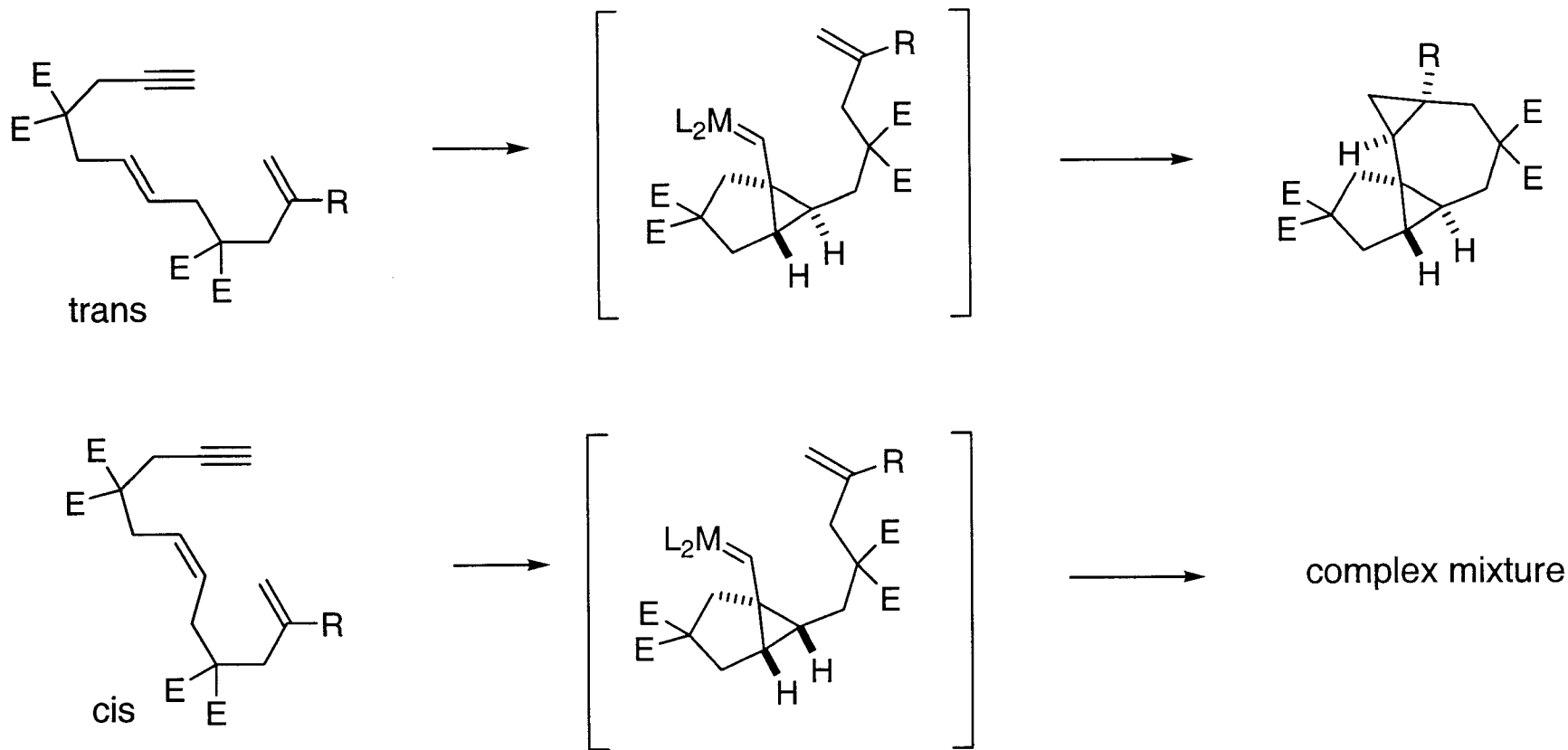
Diene-yne: Protecting Groups with a Lewis Basic Site



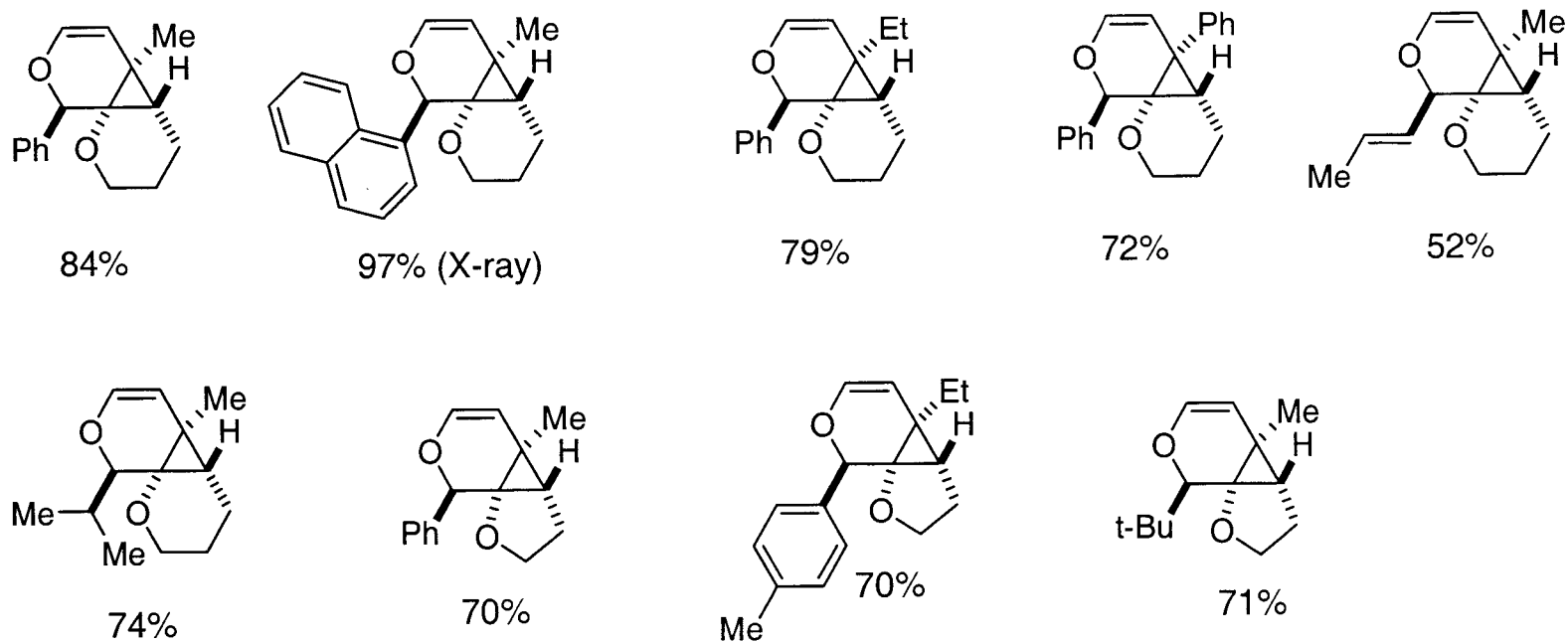
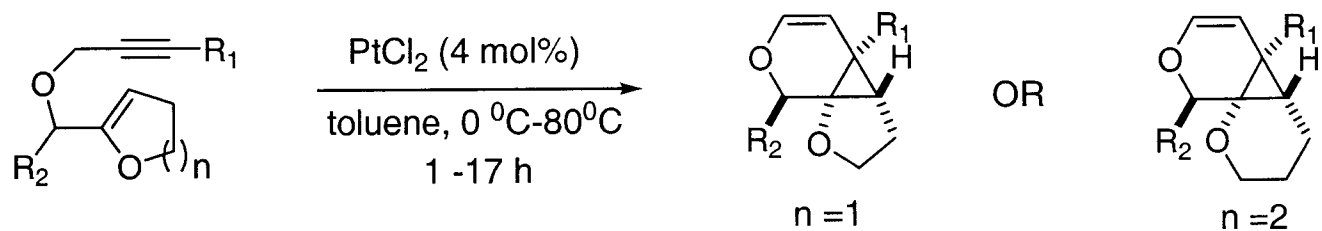
Diene-ynes: Rapid Access to Polycyclic Compounds



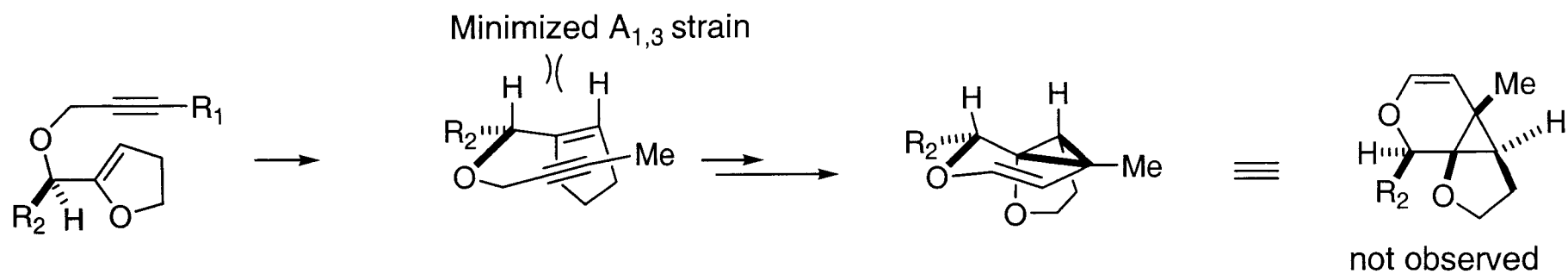
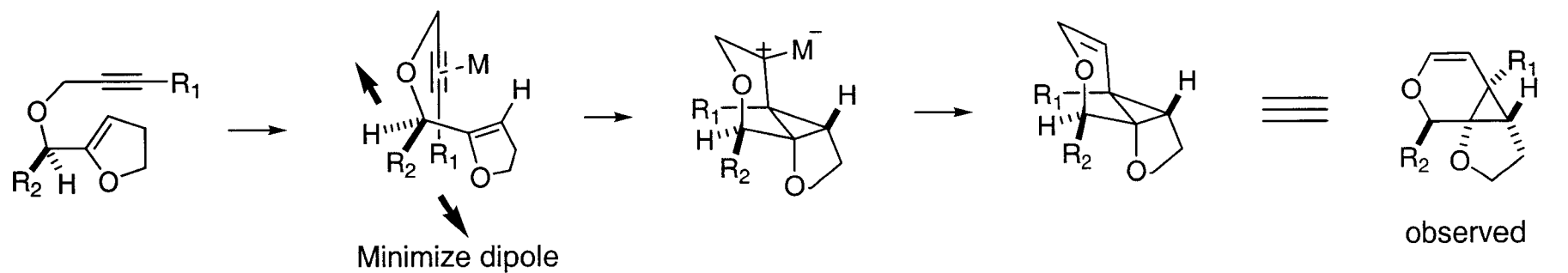
Stereospecificity



Tethers Bearing Enol Ethers as Nucleophiles



Relative Stereochemistry



Conclusions

- Provides a new approach to the synthesis of cyclopropane derivatives
- Provides a rapid access to polycyclic compounds from simple acyclic precursors.
- Highly atom economical
- Tolerates variety of functional groups
- Mechanistically distinct from those catalyzed by palladium complexes and ruthenium carbene based complexes.
- The development is still in an early stage.
- Substrates with oxygen-containing tethers are limited.
- Lack of stereochemistry controlling elements